The Australasian Bat Society Newsletter

Number 28 April 2007

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– Instructions for contributors –

The *Australasian Bat Society Newsletter* will accept contributions under one of the following two sections: Research Notes, and all other articles. There are two deadlines each year: **31st March** for the April issue, and **31st October** for the November issue. The Editor reserves the right to hold over contributions for subsequent issues of the *Newsletter*, and meeting the deadline is not a guarantee of immediate publication.

Opinions expressed in contributions to the Newsletter are the responsibility of the author, and do not necessarily reflect the views of the Australasian Bat Society, its Executive or members.

For consistency, the following guidelines should be followed:

- Emailed electronic copy of manuscripts or articles, sent as an attachment, is the preferred method of submission. Manuscripts can also be sent on 3½" floppy disk, preferably in IBM format. **Please use the Microsoft Word template if you can (available from the editor).** Faxed and hard copy manuscripts will be accepted but reluctantly! Please send all submissions to the *Newsletter* Editor at the email or postal address below.
- Electronic copy should be in 11 point Arial font, left and right justified with 16 mm left and right margins. Please use Microsoft Word; any version is acceptable.
- Manuscripts should be submitted in clear, concise English and free from typographical and spelling errors. Please leave two spaces after each sentence.
- Research Papers should include: Title; Names and addresses of authors; Abstract (approx. 200 words); Introduction; Materials and methods; Results; Discussion; and References. References should conform to the Harvard System (author-date; see recent *Newsletter* issues for examples).
- Technical notes, News, Notes, Notices, Art etc should include a Title; Names and addresses of authors. References should conform to the Harvard System (author-date).
- All pages, figures and tables should be consecutively numbered and correct orientation must be used throughout. Metric units and SI units should be used wherever possible.
- Some black and white photographs can be reproduced in the Newsletter after scanning and digital editing (consult the Editor for advice). Diagrams and figures should be submitted as 'Camera ready' copy, sized to fit on an A4 page, or electronically as JPEG, TIFF or BMP image files. Tables should be in a format suitable for reproduction on a single page.
- Research Notes will be refereed, and specialist opinion will be sought in some cases for other types of articles. Editorial amendments may be suggested, and articles will generally undergo some minor editing to conform to the *Newsletter*.
- Please contact the *Newsletter* Editor if you need help or advice.

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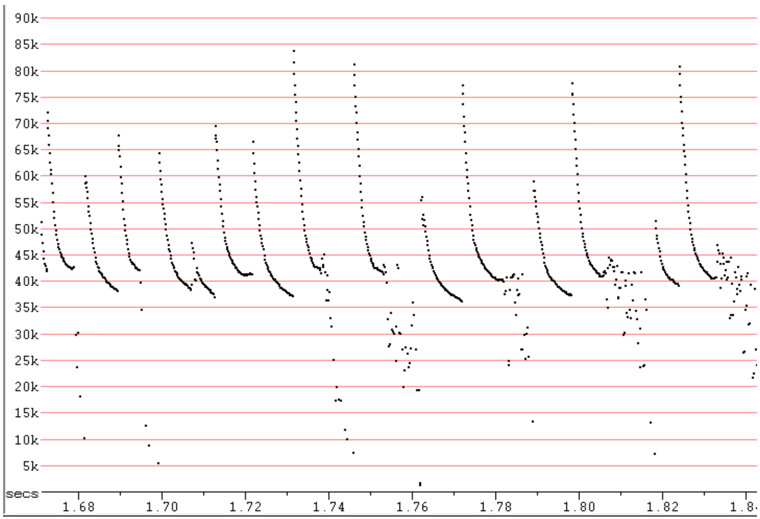
– Editorial –

This is our largest issue yet. Thanks again to all who contributed, and to Lindy once again for checking and printing.

It was great to meet like-minded bat-folk recently in Sydney for our own joint symposium with the RZS NSW, and again in Thailand for the 1st International South East Asian Bat Conference. Both conferences were brilliant, and while they energised me spiritually, they also left me somewhat exhausted. My sincerest thank you to all involved.

I will leave you with some images from Thailand and Vietnam. Please always have at the forefront of your minds thoughts of submitting to our most excellent *Newsletter*.

Kyle Armstrong
***Newsletter* Editor**



Above: *Aselliscus stoniczkanus* and *Megaderma lyra* from Ba Be National Park in Vietnam. The echolocation trace is from a Thai pipistrelle, showing a remarkable ability to alternate the frequency in successive pulses. These bats flew around our hotel in Phuket, and gave good examples of frequency-labile sequences and social calls.

Front cover: Taken from the front cover of our proceedings from the recent conference in Sydney. Photo by Vivien Jones.

– President's Report –

What a fantastic turn-out to the joint RZS of NSW and ABS symposium on "Biology and Conservation of Australasian Bats"! I dare to say that it was probably the largest congregation of Australian battos (approximately 160) to "roost" in one location at the same time. It provided me with the opportunity to meet some of the guru's of the Australian bat world for the first time: Les Hall, Len Martin, Harry Parnaby and Hugh Spencer to name but a few. Such was the demand from prospective attendees that the conference organisers had a waiting list of another 20 or so wishing to attend. The abrupt end of the proceedings because of the fieldtrip, meant that I was not able to give my closing address, so I will take this opportunity to put my address into written format.

"I would like to take this opportunity to thank all the attendees of the symposium. The success of the symposium can be best measured by the fact that a waiting list was needed, such was the demand. I would like to thank all our presenters, the range of topics would have catered for all interests and in some cases probably created new interests. In particular I would like to thank our international presenters: Ya-Fu Lee, National Cheng Kung University Taiwan; Tom Griffiths, Illinois Wesleyan University USA, Chris Corben USA, and Art Polkanov, Department of Conservation New Zealand.

The presentations over the three days were all very engaging and at the risk of offending many, there were five presentations that really struck a chord with me, those by Elery Hamilton-Smith, Sue Hand, Les Hall, Art Polkanov and Dan Lunney.

Elery's thought provoking opening presentation covered a range of topics. The one of particular interest to me was the failure of the tertiary educational system in teaching students an understanding of the scientific process. Coming from an educational background, it has made me reflect on whether I spend enough time educating students on the scientific process, or whether I place too much emphasis on the importance of the final output.

The presentations from Sue and Dan included reflections from their fieldwork in the 1970's, 1980's and through to the present, though what struck me in both was the human element, the life-long relationships that are formed. Once again it made me reflect on my most productive and enjoyable field trips. The human element was always there regardless of whether the desired project outcomes were met. I now find the experience is meaningless unless a colleague, mate or partner is there to share it with you.

Les Hall's presentation highlighted that once you are hooked, bats are likely to be a lifelong passion. Forty-plus years are testament to Les's bat obsession. It made me consider what it is about bats that got me hooked, aside from them being cute buggers? We still know so little about them because of their cryptic behaviour, and as a consequence this still provides many challenges for research, and I love a challenge of the batty kind. Bat work also offers the opportunity to travel to exotic and not so exotic places. Les's talk has given me the drive to move beyond my south-eastern Australia comfort zone and get out and chase bats in an exotic place somewhere around the globe.

And finally there was Art Polkanov's presentation. My presentation followed Art's, and you could not get two more opposing survey techniques. Art's presentation covered the use of dogs in bat surveys to find roost sites. My thoughts after Art had finished question time was: how do you top that?! What captivated me most, along with many other attendees I spoke to that evening, was not just the effectiveness of the technique but more importantly the simplicity and purity, unlike my use of ultra high tech survey methods. It has got me reflecting on our use of, and in some instances, our reliance on technology. Are we making our surveys more complex than they need to be?

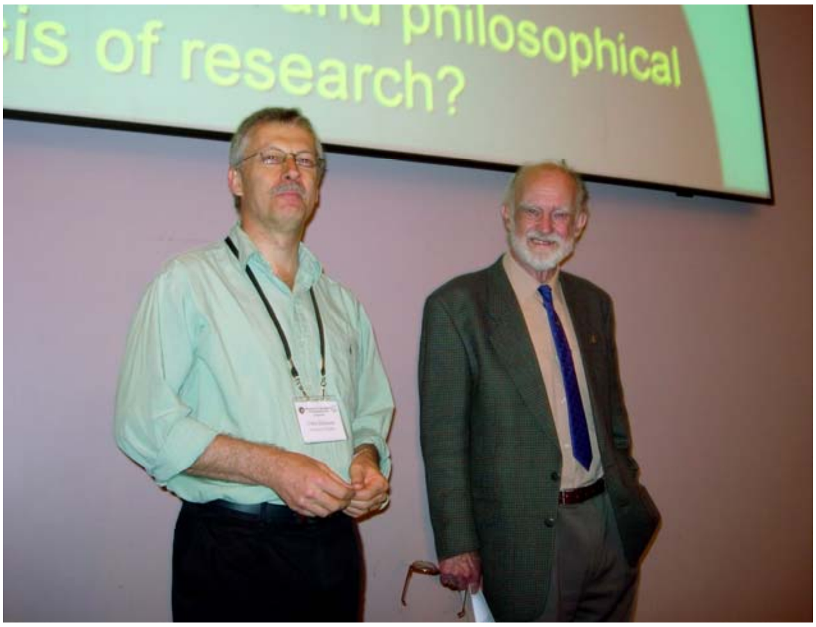
In closing I would like to thank the following people:

Audio Visual – Peter Banks, Susan Campbell, Mark Chidel, Lisa Evans, and Scott from the Australian Museum
Venue – Lisa Wong and Mark Conolly
Posters – Jessica Bryant, Billie Roberts, Andrew Smith, Jackie Chan, Murray Ellis, Stephanie Snoyman
Flying Fox Fieldtrip – Bernard Proctor, Anja Divljan and Kerryn Parry-Jones
Thermal Imaging Fieldtrip – Greg Richards, Marg Turton and Katie Oxenham

A special thank you to the Symposium Organisers – Peggy Eby, Lindy Lumsden, Brad Law and Dan Lunney.

Rob Gration
ABS President

Rob Gration giving the ABS Welcome Address *(photo Nancy Pallin)*



Chris Dickman gave the RZS NSW Welcome Address, and Elery Hamilton-Smith gave a Keynote Address *(photo Nancy Pallin)*

– Australasian Bat Society Inc: Business and Reports –

AUSTRALASIAN BAT SOCIETY, INC.
ABN: 75 120 155 626

Minutes of the 2007 ABS Financial Annual General Meeting RZSNSW / ABS Symposium 13 April 2007

1. Open attendance and apologies
The meeting opened at 5.15 pm

Apologies:
Damian Milne, Grant Baverstock, Marc Irvin

Present:
Rob Gration, Greg Richards, Lindy Lumsden, Craig Grabham, Maree Kerr, Kyle Armstrong, Terry Reardon, Nancy Pallin, Bruce Thompson, Greg Ford, Deedee Woodside, Trish Peterson-Wimberley, Terry Wimberley, Anne Williams, Jenny Maclean, Martin Schulz, Roger Coles, Linda Collins, Sonia Stanvic, Carole West, Gillian Bennett, Dianne Vavryn, David Gee, Juliana Venning, Louise Saunders, Marjorie Beck, Narawan Williams, Marg Turton, Ray Williams, Hugh Spencer, Murray Ellis, David Jackson, Michael Pennay, Annette Scanlon, Stan Flavel

2. Ratification of the Minutes of AGM, Auckland, New Zealand 2006
Moved by Craig Grabham, seconded Lindy Lumsden, motion was carried.

3. Reports from executive officers

President's Report – Rob Gration
Rob Gration's report is included.

1st Vice President's Report – Greg Richards
Greg Richards reported on activities during the year.

2nd Vice President's Report – Lindy Lumsden
Lindy Lumsden reported on her activities, including co-organising the ABS/RZS symposium and interface with the public through ABS website.

Secretary's Report – Maree Kerr
Maree Kerr reported that the ABS executive met via email through the year on various issues and asked members to bring issues to the executive that they would like the ABS to act on.

Treasurer's Report – Craig Grabham
Craig Grabham presented the Treasurer's report. The Treasurer's Report is included.

Lindy Lumsden moved that the Treasurer's report be accepted.
Ray Williams seconded the motion. Carried.

Membership Officer's Report – Damian Milne
Lindy Lumsden presented the Membership Report for Damian Milne. Damian's report is included.

Editor's Report – Kyle Armstrong
Kyle read his report to the members. Kyle's report is included.

4. Business arising from minutes
Newsletter
At the 2006 AGM, a motion was passed to change the name of the society newsletter to "Australasian Bats". The newsletter editor, Kyle Armstrong, was not at the AGM in 2006 and had not been able to enter the discussion at that time. The editor brought to the attention of ABS members some issues with changing the name of the newsletter (see Editor's Report). The name change to the newsletter has not yet been instigated.

Kyle Armstrong moved that "That the name of the ABS newsletter be changed back to the original name *Australasian Bat Society Newsletter".* Seconded Greg Richards, motion was carried.

5. Other business

- **Gift Fund.** The Executive informed the ABS members that the arrangements for setting up the Gift Fund were now formed.
- **Bat workers' Manual DVD.** Rob Gration has undertaken to complete the DVD by 1st December. Video and still footage is still required for sections on trip wires, radio-tracking, flying-fox mist nets used in Royal Botanic Gardens, Sydney, and Constantine (harp) trapping.
- **Barbed Wire Project.** Jenny Maclean described the TSN Barbed Wire Project on behalf of Carol Booth and herself. The aim of the project is to raise awareness of barbed wire as a threat to wildlife. The project focuses on three threatened species affected by barbed wire:
  - Grey-headed flying-fox
  - Spectacled flying-fox
  - Mahogany glider

  The executive supports this project and has approved funding for the printing of a brochure. Jenny Maclean will send the draft brochure to the ABS executive for approval, and the ABS logo will be placed on the brochure. The ABS will link the project website to the ABS website.
- **Communication strategy.** Martin Schulz asked if the society was ready for a media officer. It was agreed that a Communication strategy was necessary and the extended executive committee will further this and prepare a draft communication strategy for the approval of members.

6. Next Meeting
The 2008 AGM will be held at the 13th ABS Conference in the week after Easter at Charles Sturt University, Albury-Wodonga Thurgoona Campus, Thurgoona, NSW. The executive committee will discuss the FAGM for 2009 and the 2010 AGM.

7. Close
The meeting closed at 6.00 pm.

2007 FAGM President's Report

Rob Gration

I have just competed my first year as ABS President and I'm pleased to say that it has been a relatively uneventful one. This is due to the support I received from members of the executive, in particular Lindy Lumsden.

I'd like to thank the elected executive committee and extended committee for their input into the operations of the ABS. Without their voluntary contribution our society would not be able to function. I would also like to thank our members for your continuing support. The ABS is only as strong as its membership. The members of our society can rest assured that the executive meetings are not just a rubber stamp process. There is often lively debate and the end result is that the best interest of the Society and its members is always the final outcome.

The Anabat Reporting Standards have been finalised and are now in the process of being distributed to Government Agencies, consultants, researchers and those who undertake bat related projects. I would like to both congratulate and thank Terry Reardon and Michael Pennay for the work they put into producing this document. We now need to disseminate this document to all those involved in projects involving bat surveys and more specifically where bat call analysis is undertaken. It is proposed that a number of members from each state be responsible for distributing the standards. Those who would be prepared to undertake this task can contact me via email (rgration@yahoo.com.au) and I will forward an electronic version to you.

Following on from the Anabat Reporting Standards, the ABS executive is proposing to develop guidelines / standards for undertaking both pre- and post-construction bat surveys at wind farms. We will endeavour to have this document available prior to the 2007 south-eastern Australian bat season. I have also committed myself (with lots of help from Terry R) to completing the Australian Bat Workers DVD Manual by December this year. I encourage members to keep pestering me on how it is going, as sometimes I need a little push.

2nd Vice President's Report

Lindy Lumsden

The 2nd Vice President has two main roles: to coordinate the organisation of the biennial Australasian Bat Society Conference and to disseminate information to the general community. Although 2007 was a 'non-conference year', we held a joint Royal Zoological Society of NSW and ABS symposium, of which I was one of the organisers. I think everyone will agree the symposium was a great success and we hope that the majority of people that presented papers at the symposium will also write their paper up for the proceedings to be published by the RZS. As for disseminating information to the general community, this has come mainly from the steady stream of messages left on the website which I try to answer regularly.

Treasurers Report to the Australasian Bat Society for the Financial Year ending 31 December 2006

Craig Grabham, Treasurer

	$	% (of income)
Income		
Membership subscription	$9,509.75	94.3%
Interest (Cash Management)	$347.93	3.5%
Interest (Cheque)	$135.49	1.3%
Interest (Gift Account)	$4.64	0.0%
Donations (ABS Gift Fund)	$82.00	0.8%
TOTAL INCOME	$10,079.81	100.0%
Expenditure		
Membership Management (renewals postage, etc)	$30.41	-0.3%
Newsletter (production & postage)	$3,921.09	-38.9%
Insurance (public liability)	$2,128.50	-21.1%
Executive (ie. webpage production & postbox rental)	$86.86	-0.9%
Merchant Fees (Credit card facilities)	$1,215.89	-12.2%
Bank fees (Cheque)	$112.50	-1.1%
Bank fees (Cash Management)	$165.00	-1.6%
Bank fees (Gift)	$0.00	0.0%
TOTAL EXPENDITURE	$7,660.25	-76.0%
SURPLUS (DEFICIT)	**$2,419.56**	24.0%
GST Refunded from ATO	$154.00	
GST Paid to ATO	$512.00	

Membership	
Cash inflow	$9,509.75
Costs	$30.41
Surplus	$9,479.34

Bank account costs	
Cash inflow	$488.06
Cash outflow	$1,493.39
Deficit	$1,005.33

Summary		
Membership	$9,479.34	99.1%
Donations	$82.00	0.9%
Newsletter	$3,921.09	-41.0%
Insurance	$2,128.50	-22.3%
Bank accounts	$1,005.33	-10.5%
Executive	$86.86	-0.9%
Net result	**$2,419.56**	25.3%

Surplus comprises	
Excess of subs	$2,419.56

ASSETS AT 31 DECEMBER	**2006**	**2005**	**Change**
ABS Cash Management Trust (Investment)	$7,283.41	$7,144.96	+ $138.45
ABS Cheque Account	$26,401.26	$20,270.47	+ $6,130.79
ABS Gift Fund (Donations)	$1,034.70	$1,030.06	+ $4.64
TOTAL ASSETS	**$34,719.37**	**$28,445.49**	**+ $6,273.88**

Auditor's Report

I have audited the accounting records of the ABS and find they have been properly prepared and present a true and fair view of the affairs of the Society for the calendar year 2006
Robert Bender, B Comm.

Membership Report

Damain Milne, Membership Secretary

The total number of ABS members increased to its highest level ever in 2006 to 292 (the previous highest was 283 in 2002). There were 17 new members and just 7 members who either resigned or their membership expired. In 2005, there were a lot of members (66) who were unfinancial (i.e. had not paid their membership fees for more than a year). The situation improved in 2006 with 50 members unfinancial.

Membership renewals so far this year (as of 24 March 2007) have been good with 101 members yet to renew their membership for 2007 and already this year another 17 new members have joined the ABS which means the total number of members is likely to crack the 300 mark in 2007. This high number of new members is probably a result of the interest generated by the joint ABS/RZS conference.

	31 Dec 2004	**31 Dec 2005**	**31 Dec 2006**
Financial members	229	209	242
Exchange / life members	7	7	7
Subtotal	236	216	249
Members unfinancial for 1 year	25	51	31
Members unfinancial for 2 years	13	15	19
Total members (based on 2 yr unfinancial)	274	282	292
% of members financial	73.9%	76.7%	82.9%
Total members (based on 1 yr unfinancial)	261	267	273
% of members financial	79.5%	70.9%	88.6%

Also this year, ABS members were offered two new options on their renewal forms: to receive their ABS correspondence electronically (either wholly or partially); and to have their membership renewed automatically each year. Of the 180 responses received so far: 42 members chose to receive all correspondence electronically; 22 members chose to receive hard copies of the Newsletter via the post and all other correspondence (i.e. renewal forms and receipts) electronically; and 116 members chose to receive all correspondence via the post. For the automatic membership renewal, 14 members have chosen this option.

Editor's report

Kyle Armstrong

In the past year, the ABS has continued to produce 2 issues – April 2006 (issue 26) and November 2006 (issue 27). The last issue was two months late, and I offer my apologies for that.

In the past few issues, we have not had financial support through commercial advertisements, mainly because I have not attempted to solicit them. However, support through advertisement of bat-related products and services is still desired, and enquiries / suggestions are always welcome.

Compilations of the ABS Newsletter issues 1 – 25, and the entire 'Macroderma' journal series have been made available as PDFs on CD. These were first sold at the conference in New Zealand, and are still available. I see such compilations as an excellent way of increasing the exposure of our society, because newer members and those overseas will be able to access the history of our society more easily. This idea follows the lead taken by Terry Reardon in his compilation of 'Australian Bat Research News'. We might consider obtaining ISBNs for all compilations.

At the last AGM in New Zealand, a decision was made to change the name of the Newsletter. I was unable to attend this meeting and was therefore unable to comment. At the following email meeting of the executive (September 2006), I expressed my disagreement with the change, and outlined several reasons. The outcome of the resulting discussion was to delay the change until it could be discussed further at the present AGM. I therefore offer my reasons against the name change for consideration by the members of the ABS.

My understanding was that there were two reasons for the change:

1. The society was seeking to increase our exposure by encouraging Australian libraries to accept individual issues of our Newsletter on a regular basis. Some libraries were apparently reluctant to take a serial that was released as a newsletter.
2. The new name sounded better.

While I like the proposed new name, I suggest that the reasons for keeping our current name are stronger:

1. Serials benefit from the continuity of their name. Changing it confuses people, especially members to come in the coming years, and those from overseas. If we want wider readership outside our current society, I suggest that we would benefit more from continuity than a name change. The current title also incorporates our society name.
2. A name change also requires changing the ISSN. This is simple enough to organise, but goes against the point of having one.
3. We already have three serials associated with our society - Macroderma, Australian Bat Research News, The Australasian Bat Society Newsletter, plus the compilations of each of these by Chris Tidemann, Terry Reardon and myself respectively. We must consider the disadvantages of adding a fourth serial.
4. We should not compromise our publication simply because some libraries are not interested in it. I understand their viewpoint, as our society newsletter is not a journal-standard serial. However, we cannot be certain that a name change will encourage more library subscriptions, and I suggest that the benefits of increased library holdings of accumulated issues do not outweigh the negatives listed here. I suggest considering an alternative – that we send complimentary copies of compiled issues to libraries, with an ISBN if we need to.
5. Our Newsletter serves as a record of our society. It is our public face, and the name of our publication fully represents its contents. The Newsletter regularly (almost every issue) carries a report of activities outside our Australasian region. In the past issues we have had contributions that detail bats and trips to Myanmar, Malaysia, Vietnam, Japan, Taiwan, Slovenia, Swaziland and Panama. Our society is indeed predominantly Australasian in terms of membership, but our reading interests go beyond our region. Also, our publication is indeed a Newsletter. It presents a range of article types, is a record of the activities of our members, and as such it is most appropriate to call it a Newsletter.

Despite my role as the editor, my opinion is that of one person only, but I ask that the membership consider these issues before changing the name.

To conclude, I would like to thank all contributing members for their submissions. It has been a privilege to compile each issue.

Abstracts from the Royal Zoological Society of New South Wales and Australasian Bat Society
Symposium on the Biology and Conservation of Australasian Bats

KEYNOTE ADDRESS

Reflections on the evolution of bat research

Elery Hamilton-Smith, AM
Professor, Environmental Studies, Charles Sturt University, Albury, NSW 2640;
Chair, IUCN / WCPA Task Force on Caves and Karst.

This paper combines personal experience with a more objective overview of bat research in Australia from 1954 to the present day and even venturing into probable futures. It starts with a handful of virtually self-taught researchers who developed a significant ecological and behavioral understanding through systematic observation. Simple technologies such as bat banding, and Constantine traps were a great leap forward.

Today research faces a potential problem in the immense blossoming of electronic technologies that enable us to measure and record almost anything, but it may fail to genuinely increase our understanding. It may also overlook issues of respect and care for the animals who share in our research. Finally, in an era of environmental change, bats may yet provide valuable early-warning systems.

CONSERVATION STATUS I

From Action Plan to Regional Action: a review of bat conservation in Queensland

Greg Ford[1], Bruce Thomson[2] and Carol Booth[3]
[1] *Queensland Murray-Darling Committee Inc., Toowoomba QLD 4350.*
[2] *Environmental Protection Agency, Southern Region, Toowoomba QLD 4350.*
[3] *6 Henry St, Chapel Hill QLD 4069.*

The Action Plan for Australian Bats recognised a total of 90 Australian taxa and of these, 69 or 77% occur in Queensland. Since the publication of the Action Plan, taxonomic reviews and other changes have altered these figures slightly, so that if we exclude one extinct species (*Pteropus brunneus*), remove subspecies from the equation and recognise a number of other taxa that are generally regarded as good species, then the numbers approximate 64 Queensland species out of approximately 78 in Australia, or 82%. In either case the proportion is high, and this is not surprising, considering the size of the State and the range of environments encompassed.

At the time of the Action Plan, Queensland was recognised as having seven taxa with Threatened Species status. Major threatening processes included tree-clearing, the destruction or disturbance of cave and mine roost and maternity and habitat alteration through changed fire regimes or grazing. Other species-specific threats included crop protection systems at orchards for several *Pteropus* species. Since that time, targeted research, wildlife surveys, advances in taxonomy and even anecdotal observations have altered our perceptions of the conservation status of many species.
Progress has also been made in terms of conservation planning and the mitigation of threatening processes. Recent legislation has significantly reduced tree-clearing operations and new approaches have been developed at the State and Regional levels to more effectively target other threatening processes. Even so, the greatest problem confronting bat conservationists is a lack of detailed knowledge of species' biological and population parameters. Some past conservation programs are reviewed in this context and future recommendations are proposed.

Review of the distribution and status of New South Wales and the Australian Capital Territory bat fauna

Michael Pennay[1], Bradley Law[2] and Dan Lunney[3]
[1] *NSW Department of Environment & Conservation, PO Box 733, Queanbeyan NSW 2620.*
[2] *NSW Department of Primary Industries, PO Box 100, Beecroft, NSW 2119.*
[3] *NSW Department of Environment & Conservation, PO Box 1968, Hurstville NSW 2220.*

New South Wales (NSW) including the small enclave of the Australian Capital Territory (ACT) has a diverse bat fauna of 39 taxa (34 microchiropterans and 5 megachiropterans). In NSW 22 (56%) of chiropteran taxa are listed as threatened, 20 as vulnerable, 1 as endangered and 1 extinct under the *Threatened Species Conservation Act 1995*. This reflects the recognition of the threatened status of most NSW bats under the first threatened species legislation in NSW, the *Endangered Species (Interim Protection) Act 1991*. There are no threatened bats listed in the ACT under the *Nature Conservation Act 1980*. The main reasons for listing of NSW threatened bats were reduced population or distribution, ecological specialisation, concentrated populations and habitat loss.

We mapped the geographic distribution and relative density of observations for each species using weighted Kernel Density Estimate models based on 92,000 unique records of more than 3 million individual bats observed in NSW and ACT. Distribution and observation data were used to investigate trends in reporting rates for each taxon over the past decade using a non parametric rank analysis to determine the annual ratio of observations per species versus a surrogate for effort. We also investigated regional patterns in the distribution of the bat fauna using PATN association and classification analysis to identify 6 distinct 'bat regions' based on the species composition of the 18 biogeographic regions within NSW and ACT.

We found that survey effort and data were unevenly distributed spatially, taxonomically and temporally. Fifty-six percent of all records are from three coastal bioregions, 5 species account for 52% of all records, and conversely over 50% of the species account for less than 5% of all records. Further, most (60%) of all records are from the last 10 years. As most of our data has been collected by large-scale inventory type surveys, we recommend that greater attention should be devoted to targeted research and increased long term monitoring. Without monitoring, identifying trends in species and populations is almost impossible. The status of most bats will remain threatened without action to ameliorate threats and monitor changes in population and distribution.

The conservation status of bats in Victoria

Lindy Lumsden[1], Andrew Bennett[2] and Peter Menkhorst[3]
[1] *Arthur Rylah Institute, Department of Sustainability and Environment, Heidelberg, VIC 3084.*
[2] *School of Life and Environmental Sciences, Deakin University, Burwood, VIC 3125.*
[3] *Department of Sustainability and Environment, East Melbourne, VIC 3002.*

Twenty-three species (or taxa) of bats are known from Victoria: 21 species of microchiroptera and two megachiroptera. Five species are listed as threatened under the Victorian *Flora and Fauna Guarantee Act* 1988 (FFG Act): Grey-headed Flying-fox *Pteropus poliocephalus*, Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*, Eastern Horseshoe Bat *Rhinolophus megaphyllus*, Common Bent-wing Bat *Miniopterus schreibersii* and Eastern Long-eared Bat *Nyctophilus timoriensis* (south-eastern form). To be listed under the FFG Act, species are nominated, assessed by a Scientific Advisory Committee and approved by the responsible Minister. Threat categories are not included under the legislation. The Department of Sustainability and Environment maintains an *Advisory List of Threatened Vertebrate Fauna in Victoria*, which assesses the conservation status of species based on IUCN criteria and categories. All species listed as threatened under the FFG Act are included in the Advisory List, with the exception of the Yellow-bellied Sheathtail Bat which is now considered a vagrant to Victoria. The southern subspecies of the Common Bent-wing Bat *M. s. bassanii* is listed as Endangered, while the eastern subspecies *M. s. oceanensis* and the remaining three species are listed as Vulnerable. The Southern Myotis *Myotis macropus* is listed as Near Threatened.

Extensive regional surveys throughout Victoria over the past three decades have provided a relatively comprehensive understanding of the distributional patterns of most species; although recent records continue to reveal range extensions. Ecological studies have been undertaken on some species; however, detailed data are lacking on the ecology and habitat requirements of most species. The greatest threats to bat populations are the loss and modification of their habitats. Targeted ecological research and long-term monitoring programs are required to determine population trends and to better understand threats to the continuing survival of healthy populations of bats in Victoria.

CONSERVATION STATUS II

Status and conservation of bats in Tasmania

Michael Driessen[1], Raymond Brereton[2] and Matthew Pauza[1]
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Compared with mainland Australia the diversity of bats in Tasmania is low. In all, there are eight species of native bats recorded in Tasmania; Gould's Wattled Bat, *Chalinolobus gouldii*, Chocolate Wattled Bat, *C. morio*, Large Forest Bat, *Vespadelus darlingtoni*, Southern Forest Bat, *Vespadelus regulus*, Little Forest bat, *Vespadelus vulturnus*, Eastern False Pipistrelle, *Falsistrellus tasmaniensis*, Lesser Long-eared Bat, *Nyctophilus geoffroyi* and Greater Long-eared Bat, *N. timoriensis*. There has been a limited amount of bat research and survey in Tasmania and systematic surveys have not been undertaken across Tasmania. However, all species appear to be widely distributed and none are listed under Tasmania's *Threatened Species Protection Act 1995.*

Conservation status of the bats of South Australia

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Twenty-seven bat species have been recorded in South Australia. The National Parks and Wildlife Act 1972 recognises three categories of threatened status, namely Endangered, Vulnerable and Rare. The criteria for listing under these categories have recently changed, and are now based on IUCN criteria. In the latest review currently before cabinet, twelve bat species fall into one or other of these categories. There is a move in the State to scrap these old categories and adopt the IUCN categories. Gaps in our knowledge of South Australian bats will also be discussed.

The current status of bats in Western Australia

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Understanding of the distribution and ecology of some Western Australian bats has advanced considerably in the last ten years, while knowledge of others remains basic. The state has one species listed in the highest conservation level under state legislation (*Rhinonicteris aurantia*), and one population of this species is listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Six other species are included on the Department of Environment and Conservation's Priority Fauna Listing based on their known distribution and representation on conservation and threatened lands (*Falsistrellus mackenziei, Hipposideros stenotis, Macroderma gigas, Mormopterus loriae cobourgiana, Nyctophilus timoriensis* [central form] and *Vespadelus douglasorum*). These listings mainly reflect lack of knowledge and perceived threat. Recent research on *R. aurantia* and *M. gigas* has provided much relevant information for assessing development proposals, mainly in the Pilbara where plans for iron and gold mines sometimes coincide with their habitat. Proactive consultative projects that address these issues were begun in the past few years and involve a variety of approaches from surveys and preservation of adits to genetic work. Some groups would benefit from taxonomic resolution especially *M. l. cobourgiana* and *N. timoriensis* given their current conservation status. Other more common species also require attention (e.g. *Vespadelus finlaysoni, Mormopterus form sp. 4*) and there is the possibility of a new species of *Vespadelus* in the Kimberley. The impact of logging, mining and other disturbances involving forest clearing in the south west are largely unknown, but studies have begun. The status of cave occupancy of bats in south west caves was recently assessed. A series of studies on aerodynamics, foraging strategy and call design has contributed much to the understanding of the ecology of WA bats. While keys are still unavailable for identifying bats from their echolocation calls, new methods are now available that help distinguish some species with similar call design.

Recent Amendments to the Environment Protection and Biodiversity Conservation Act 1999 and their relevance to bat conservation

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The most recent amendments to the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) commenced on 19 February 2007. These amendments provide, among other things, greater flexibility in the assessment and referral process, establish a new process for listing threatened species, ecological communities and key threatening processes, and enhance the EPBC Act's compliance and enforcement regime.

Of particular relevance to bat conservation are the new procedures that relate to the listing and recovery of threatened species and ecological communities. New procedures include the formulation of a prioritisation list for nominations, the possible adoption by the Minister of a conservation theme for new nominations and the establishment of an annual assessment cycle. The new process is designed to improve the effectiveness of listing with a more strategic approach focussing on those species in greatest need of protection.

The amendments change the focus from recovery plans to recovery 'action', primarily through ensuring that there is approved conservation advice at all times for each listed threatened species and ecological community. The Minister can decide whether a recovery plan is required for a threatened species or ecological community or whether to discontinue use of an existing plan.

The changes to the EPBC Act will ensure that matters protected by the Act continue to receive the highest possible level of protection. Implementation of these changes will cut unproductive 'red tape' and enable quicker and more strategic action to be taken on emerging environmental issues.

Is the fat lady singing? Contemplations on the amendment of an environment Act

Nicola Markus

Environment legislation is fundamentally important. It determines conservation priorities, keeps a tally of how threatened species, ecological communities and conservation efforts are tracking, sets the frameworks by which conservation happens, regulates activities that impact on the environment, and it gives direction to the funding schemes that fund conservation efforts. The federal Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) was hailed as a progressive and potentially powerful piece of legislation when it first commenced in July 2000. In December 2006, a suite of amendments to the Act were passed that have broad implications for the conservation of all threatened species, flying foxes and microbats among them.

Bats – where to from here?

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Bat conservation and bat research are constantly limited by lack of funds. This paper will present some approaches aimed at improving this situation and will then invite discussion from the audience.

BEHAVIOURAL ECOLOGY

The prey-predator relationship between field crickets (*Teleogryllus* spp.) and echolocating bats in Australia

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In the predator-prey relationship between bats and insects, Australian field crickets (*Teleogryllus* spp.) have become a model system. On the sensory side, neural processing of ultrasound by the field cricket auditory system is well known although behaviourally, experiments have relied on tethered animals responding to artificial 'bat-like' stimuli. At present, there is no direct evidence that bats prey upon *Teleogryllus* spp. in nature, and that their ultrasound (bat) avoidance behaviour has any real adaptive significance. To put ultrasound avoidance behaviour into a more natural context, the response of unrestrained (walking) *Teleogryllus commodus* has been studied in the laboratory, by replaying pre-recorded bat echolocation calls. The calls come from Australian bat species likely to be the natural predators of field crickets; a range of artificial bat-like ultrasonic pulses have been tested as well. Digital video analysis of cricket walking behaviour reveals that avoidance (negative phonotaxis) depends on the type of stimulus (artificial or real bat call) in terms of effectiveness. Experimentally, pulse repetition rate needs to be above 20 pulses per second (pps) to initiate an escape response, with a specific freeze behaviour induced at rates above 60 pps. These rates are consistent with natural bat attack sequences. Replaying real bat echolocation calls suggests that there may be a difference in the potency of signals between bat species, with the calls of *Nyctophilus* spp. being particularly effective at inducing the escape response.
The exact scenario under which field crickets are captured in the field by Australian bats remains to be determined. However the distribution of field crickets and their potential predatory bat species overlap in certain regions of Australia.

Behavioural ecology and conservation of Australia's only trawling bat, the large-footed myotis: a review

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Amongst the myriad of microbat foraging modes, fishing and trawling behaviours have arisen multiple times in different phylogenetic clades. Whilst true piscivory is rare, several myotis species show morphological adaptations to aquatic foraging. The inclusion of fish into the diet of these species has the potential to influence life-history characteristics such as the use of torpor, migration, roost selection and breeding ecology. Fishing and trawling bats also present unique conservation concerns: water quality impacts directly on both the availability and detectability of prey, and the roosting behaviour of these species is often constrained by the vicinity of suitable waterways for foraging.

The large-footed myotis, *Myotis macropus*, is morphologically and ecologically similar to overseas trawling species, and is Australia's only trawling microbat. Drought conditions are set to challenge *M. macropus*, with dramatic declines in the availability of suitable waterways and increased stress placed upon the remaining riparian vegetation. This review summarises the current knowledge of the ecology of fishing and trawling bats and presents recent results on the foraging and roosting behaviour of *M. macropus* in south-eastern Australia. In Queensland *M. macropus* forms harems and has two breeding seasons per year. There is also evidence of two birthing periods in southern Australia. *M. macropus* forages almost exclusively over water and regularly preys upon aquatic invertebrates and fish. Furthermore, *M. macropus* roosts in a variety of structures that have suitable thermal microclimates and are located within 100 m of foraging grounds. The obligate relationship between *M. macropus* and permanent waterways warns of impeding conservation challenges in the face of ongoing climate change.

Foraging strategies and diet in the Australian Large-footed myotis, *Myotis macropus*

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Several *Myotis* species glean insect prey directly from the water surface using echolocation, leading to speculation that they are capable of catching small fish at the surface. Such behaviour in *Myotis* has never been observed directly, and the only evidence for piscivory comes from the presence of fish scales in faeces collected at roost sites for the species *Myotis macropus* from Australia and *M. ricketti* from China.

This study is based on observations of *M. macropus* foraging over water at several sites in Queensland. Digital video recordings were made under infrared or red illumination and analysed frame by frame, together with synchronised echolocation call recordings. By this method, it was possible to identify and categorise the strategies used by *M. macropus* when successfully capturing or attempt to capture prey, either above or on the water surface. *M. macropus* appears to be far more successful at capturing prey directly from the water surface compared to just above it, or even during regular aerial hawking. Video footage shows that *M. macropus* gaff prey off the water surface using only their feet. Bats were observed to periodically leave and return to their foraging areas, possibly to consume prey at a night roost. Hunting bats were captured in mist nets immediately downstream from their foraging area and faeces collected for dietary analysis. Faecal pellets contained hundreds of fish scales (*Gambusia affinis, Pseudomugil signifer*) strongly suggesting that some of the video observations involved bats fishing. Further examination of the faeces revealed the remains of atyid shrimps (*Paratya australiensis*), together with parts of waterborne insects such as whirligig beetles, water beetles and mayflies.

Diet and movements of grey-headed flying-foxes (*Pteropus poliocephalus*) from a colony site at the Royal Botanic Gardens, Sydney

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The Royal Botanic Gardens in Sydney's CBD are the location of a colony of grey-headed flying-foxes. A study was conducted on this colony to determine its size, what the flying-foxes ate and where they ate it.

Over a number of catching sessions between February and August 2006, 125 grey-headed and one black flying-fox were caught in mist nets. Pollen and faecal samples were collected and analysed to determine the bats' diet. Samples were collected from bats of known age and sex so analysis would reveal possible resource partitioning within the colony. Fly-out counts were conducted on a weekly basis to determine population size and how it changed over-time. To find out where the flying-foxes went to feed, five grey-headed and one black flying-fox were fitted with radio-collars and tracked to their foraging sites.

All flying-foxes had pollen on their fur, indicating blossom visitation. *Myrtaceae* pollen was found on 94% of animals and fig fruit was the most common food type in faecal samples. There were some notable differences in diet between males and females and juvenile and adult bats but these were not significant. Population numbers fluctuated weekly from 18,900 in the breeding season to 5,400 in winter. Movements of radio-collared bats indicated that they returned to the same foraging site each night and foraged within 5km of the colony site.

This study showed that grey-headed flying-foxes from the Royal Botanic Gardens Sydney colony eat a diet consisting of native fruits and blossoms. They feed on these close to the colony site and show strong foraging-site loyalty.

Operant conditioning of the spectacled flying fox (*Pteropus conspicillatus)*

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Behavioural research with flying foxes is difficult to conduct under natural conditions in the wild, and only one laboratory behavioural study (of flying fox visual acuity) has been reported in the literature (Neuweiler, 1962).

In this free operant conditioning study, ten tame spectacled flying foxes (*Pteropus conspicillatus)* had to learn to pull levers for a juice reward in the controlled environment of a modified Skinner box. All sessions were monitored and recorded on video. The learning behaviour of the three hand-raised animals was dramatically different to that of the seven wild-raised subjects. The three hand-raised flying foxes made the association between the lever-pulling and the juice-reward in the seventh, ninth or fourteenth 10-minute session. However, the wild-raised animals did not learn this even after 15 trial sessions. In the reacquisition phase the three hand-raised subjects pulled the levers for a juice reward after a latency phase of only 30 to 65 seconds showing that learning had taken place. Great individual differences in behaviour of the three 'learners' were observed during the extinction phase, which ranged from frantic lever pulling to quiet grooming.

Two explanations for the difference in learning between the hand- and wild-raised flying foxes are advanced. The mild liquid deprivation of five to seven hours prior to the conditioning trials in the late afternoon was not enough to elicit strong searching behaviour. Severe food deprivation has been shown to work for wild *P. giganteus* (Neuweiler, 1962; personal communication, 2003). Taking into consideration the close evolutionary relationship between flying foxes and lemurs (Pettigrew, 1986), observation studies of lemurs may provide a parallel (Jolly, 1964, 1966). In lemurs, inquisitiveness toward non-food items was surprisingly low and was explained by the social environment in which the young learn by imitating the other group members. In hand-raised flying foxes the social environment is highly 'enriched' and the animals are exposed to a wide range of 'artificial' objects and stimuli, so that the animals in this study were pre-conditioned to the experimental environment.

Studies with flying foxes that give insight into their learning behaviour can be of great benefit when devising strategies for their management in the wild.

FIELD TECHNIQUES

Use of dogs in bat surveys

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Search of bats and their roosts in the wild is often a challenging task as bats are secretive and in many cases undetectable animals. Extraordinary olfaction capabilities of dogs make them the best natural tool for various wildlife surveys including bat ones. Our use of dogs in bat surveys in 1980s-90s shows that they are capable of finding bats' excrements and roosts on the surface, underground (caves and mines) and inside man-made structures with a great accuracy under the range of environmental conditions. Basic requirements for a bat detection dog are: the dog must find the target, indicate its find, and do it without disturbing or harming target animals, handler and itself. A reward-based training method has been used to develop a reliable trained alert. Body language (posture, tail or ear-set movement, facial expression etc.) is an alternative way to recognize encounters with a target smell. Dogs are able to generalize and can be trained on bats, their excrements or residual scent and then can effectively locate the source of smell they had never previously encountered. Use of dogs significantly improves field data collection, offering a risk-free, non invasive field technique to cover larger areas faster and more accurately.

Remotely interrogatable collar-mounted GPS logger for flying foxes

Hugh Spencer and Tim Miller
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Flying foxes, *Pteropus* spp. are highly mobile animals, ranging over distances often exceeding 100 km each night merely to feed, and far greater movements during times of colony shifts. Accurately monitoring movements over such distances is completely out of the scope of conventional radio-tracking technology. ARGOS satellite transponders are useful for tracking long range (inter-continental) movements but the locational accuracy tends to be very poor, about 1km.

To overcome these deficiencies and to allow us to track animals with accuracies of better than 3 meters, we have developed a solar-powered GPS-based logger, small enough (60 gm) to be carried by an adult flying fox. This logger (60,000 locations) permits us to monitor flying fox feeding behaviour, energetics and even shifts in forest phenology with changing climate, as we can visit and identify individual feeding trees. With a down-load range of up to 0.5 km, we are able to remotely download the data without actually having to capture the animal, or wait for the collar to fall off. Each collar has an integral conventional radio-tracking beacon to permit us to locate the animal for download. Data from the loggers is plotted on a GIS topographical and vegetation map data base.

We are hoping to deploy 50 units on *Pteropus conspicillatus* over the next couple of years, together with volunteers based in the field who can access known colony sites to download the data.

From this we should be able to develop a far more accurate understanding of the dynamics of flying fox behaviour, especially seasonal shifts and the distribution of food resources in the region, an understanding which should be able to provide us with predictive tools for minimising crop damage and monitoring changes due to Global warming.

Practical solutions for catching and processing Grey-headed Flying-foxes, *Pteropus poliocephalus* based on a population study at the Royal Botanic Gardens, Sydney

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Grey-headed flying-foxes, *Pteropus poliocephalus* can be difficult to catch in sufficient numbers for population studies and large numbers of *P. poliocephalus* have not been anaesthesised under field conditions. We describe methods that have proven successful and evaluate their practicality. Over the last year (23 catching nights) we caught (and banded with ABBBS bands) 390 Grey-headed Flying-foxes from the Royal Botanic Gardens colony. Between 8 and 53 bats were caught per catching night as they returned to the roost site in the early morning; depending on weather conditions and net orientation. Animals were captured using a standard 12m long mist net on pulleys attached to two 13m tall stainless steel poles, each of which is assembled from 6 smaller poles. The poles are relatively light but require four people for safe net assembly.

Detailed information was obtained from 287 individuals that were processed; the juveniles were banded and released. We anaesthetised each individual and recorded standard morphometric measurements. Pollen and faecal samples, as well as tissue samples, including blood, membrane puncture and a tooth were also collected. Six animals were additionally fitted with radio collars. The processing generally lasted under 10 minutes/animal and bats recovered from the anaesthetic within an hour. When fully alert, each bat was released back into the colony by flying it across a lawn to the roost trees. No casualties have resulted from catching or processing the flying-foxes and no processed animal has subsequently been found ill or dead as a result of this project.

Can radar technology overcome the current limitations of surveying for Southern Bent-wing Bats *Miniopterus schreibersii bassanii* at wind farms?

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The south-west region of Victoria is currently experiencing rapid growth in the number of proposed wind farms. A maternity roost and an unknown number of staging and winter roosts of the EPBC Act 1999 and FFG Act 1988 listed Southern Bent-wing Bat *Miniopterus schreibersii bassanii* are in the region. Bat detectors have been the primary tool used to survey for their presence at a proposed wind farm, however it was acknowledged by government agencies overseeing the EIS process that both the survey effort and design was lacking. This was recently addressed with the development of; 'Guidelines for bat survey in relation to wind farms'. My recent experience with the guidelines was that they are very effective in identifying most species present and provide information on habitat use. They do not, however, overcome the technical limitations of undertaking targeted surveys for Southern Bent-wing Bats. These limitations are; identification based on call signature is unresolved, can't quantify the number of bats utilizing a site, the volume of area a bat detector monitors is limited and; placing the bat detector at bat utilization height is problematic. This presentation will provide an overview on the use of radar technology and its potential to provide meaningful information on the numbers and site utilization of Southern Bent-wing Bats.

Recent Anabat developments

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Anabat is an acoustic bat-detection system using frequency division and zero-crossings analysis to efficiently detect and analyse ultrasonic bat calls. Because of its highly optimised data processing and management, it is ideally suited to both long-term passive monitoring and production of real-time sonograms. Recent developments include synchronised arrays for plotting bat positions in three dimensions, highly portable PDA based systems for active monitoring, and automated data scanning software for automated species identification.

A synchronised array of detectors uses signal times-of-arrival to determine the position of a bat each time it calls. This system has already been used to measure call intensities of wild bats. Other potential uses include plotting the trajectories of bats near wind turbines, and determination of flight direction at a cave entrance.

Active monitoring using a PDA based system has proven extremely effective. A bat detector and PDA, providing real-time Anabat displays, can be held in one hand. This system has practical advantages over heterodyne and time-expansion systems, providing useful output from even a single bat call. In field comparisons, any deficit in sensitivity was more than compensated for by a realtime, broadband, visual display, and freedom from the need for specialised hearing skills.

Automated scanning of passively-collected Anabat data has been possible for some time. A much more user-friendly version has now been implemented as part of the AnalookW software package, and this will make automated analysis of large datasets much easier and more reliable.

INFORMATION SESSION

'A quick overview of current taxonomic research in Australian microbats'.
Speakers included Terry Reardon, Glenn Hoye, Belinda Appleton and Harry Parnaby, focusing on the taxonomy of *Mormopterus* spp., *Hipposideros diadema*, *Vespadelus* spp., *Miniopterus* spp., *Nyctophilus* spp. and *Scotorepens* spp.

EVOLUTION AND SYSTEMATICS

The Riversleigh fossil bat record: a review

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In 1976, Henk Godthelp and Mike Archer, then of the Queensland Museum, discovered Microsite, a 20 million-year old bat-bearing limestone deposit on Riversleigh Station, northwestern Queensland. Less than 20 m diameter and possibly 1 m deep, Microsite contained many thousands of tiny bat bones, representing the first-known Tertiary bat assemblage in Australia. This deposit turned out to be the first of many subsequently found at Riversleigh. The additional deposits were found throughout an area of 40 sq km and included late Oligocene, early, middle and late Miocene, early Pliocene and Quaternary bat-rich assemblages. Thirty years on from that first discovery, over 300 different fossil accumulations, almost all including bats, have been recorded and sampled in what is now the Australian Fossil Mammals World Heritage Site (Riversleigh-Naracoorte). This paper will review the principal outcomes of fossil bat research at Riversleigh—the problems solved as well as the many challenges that remain.

Hyoid Morphology of Bats of the Families Craseonycteridae, Hipposideridae, and Rhinolophidae (Chiroptera)

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The hyoid musculature, hyoid apparatus, and adjacent anatomy of the bumblebee bat, *Craseonycteris thonglongyai*, and of a taxonomically and geographically broad sample of hipposiderid and rhinolophid bat species are described and illustrated in detail. Data gathered are compared with data on hyoid and adjacent morphologies of bat families described elsewhere, using outgroup hyoid morphology data from (1) tree shrews (Scandentia) and flying lemurs (Dermoptera); and (2) horses (Perissodactyla) and dogs (Carnivora). Craseonycterid bats possess a number of morphological character states that are clearly derived and that have been described previously only in rhinopomatid bats, supporting a close phylogenetic relationship between the families Craseonycteridae and Rhinopomatidae. Cladistical analysis of craseonycterid, emballonurid, hipposiderid, megadermatid, nycterid, pteropodid, rhinolophid, and rhinopomatid bats suggests that rhinolophids and hipposiderids belong in a clade that also contains pteropodids, but this result should be treated with caution, as hyoid data on pteropodids are taken mostly from imperfect and incomplete descriptions in the literature. Relationships of other bat families are less certain. Megadermatids probably are the sister group to the rhinolophid-hipposiderid-pteropodid clade. Emballonurids may be the sister group of craseonycterids-rhinopomatids. At this point in our study, nycterids do not show a clear affinity for any other family analyzed.

ECOLOGY I

Ecological separation of two *Mormopterus* species in sympatry

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Resource partitioning enables closely-related, morphologically similar species to coexist. This study investigated resource partitioning by two closely-related insectivorous bat species, the Eastern Freetail Bat *Mormopterus* sp. 2 and Southern Freetail Bat *Mormopterus* sp. 4, within their sympatric zone in northern Victoria. Thirty-six sites were sampled using harp-traps and bat detectors. A total of 159 *Mormopterus* was caught, and 961 identified echolocation passes recorded. Analysis of wing dimensions suggested that *Mormopterus* sp. 4 was a faster, less manoeuvrable flyer, which was supported by greater levels of activity in sites that were more open and less structurally complex. *Mormopterus* sp. 2 showed greater levels of activity in riparian habitats, which may be due to a preference for more mesic environments. Observations of flight patterns revealed slight differences in the two species' microhabitat use, with both species predominantly flying in the spaces between trees. Faecal pellet analysis found that Hemiptera was the most consumed arthropod order of both species. The subtle, yet significant differences in wing morphology were reflected in the slight differences in microhabitat use by the two species, and the presence of superabundant Hemipteran prey may have allowed the two species to overlap their trophic niches.

Roosting in suburban Melbourne: bat boxes versus tree hollows

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Bats living in Melbourne's suburbs face a number of challenges including high concentrations of introduced predators such as domestic cats, increased disturbance and limited natural roosts. In the last ten years, nest boxes have increasingly become a management tool to provide additional hollows for bats in suburban parkland and remnant forest. At Gresswell Wildlife Reserve in the suburb of Bundoora, there are both natural hollows and bat boxes available to a population of Gould's wattled bats (*Chalinolobus gouldii*). The aim of this study was to investigate the relative use of the two alternate roost types, and determine if there were intra-specific differences. We used radiotelemetry to locate the roost sites of six male and nine female bats, initially caught in bat boxes in January and February 2007. Roosts were found in 11 bat boxes and seven natural hollows. Both sexes used natural roosts and bat boxes, although there was a trend for females to use more of the available natural hollows than males. Roost-fidelity was variable, with some individuals shifting regularly while others stayed in the same roost for up to 15 days. Animals using boxes tended to shift roosts less often than when in hollows, especially when compared to data collected for *C. gouldii* using natural roosts in rural landscapes of northern Victoria. Suburban development changes the distribution of resources available to bats and this may influence their roosting behaviour and have consequences for social interactions, predation and parasite loads.

The composition and diversity of bat assemblages in different settings of the raised coral reef tropical forest of Taiwan

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We investigated the species composition, diversity, and seasonal variations, of bat assemblages in the uplifted coral reef tropical forest of Taiwan. A total of 584 bats of 10 species was mist-netted, which account for one third of the bat fauna of this island. *Miniopterus schreibersii*, *Hipposideros terasensis*, *Rhinolophus formosae*, and *Murina puta* were the most frequently caught and abundant species, together accounting for 79% of the relative frequency and 84% of the relative abundance; followed by *R. monoceros* and *Myotis taiwanensis*. Both the total and mean numbers of species caught peaked in May-June, whereas the mean capture rates climaxed in July-August. Most species were captured year round, *M. puta* appeared to be more abundant in winter; whereas *M. taiwanensis* was absent during late summer-early winter. The numbers of species present at interior and edge sites were similar, as was the species composition, and evenness and heterogeneity values. Capture rates, however, were two-fold higher at interior than edge sites, in particular for *H. terasensis*, *R. monoceros,* and *M. taiwanensis*; and were female-skewed, particularly for *M. schreibersi* and *R. monoceros*. The overall similarity in the species composition between the forest interior and edge sites, based on assessments of bat captures or bat passes, was nearly 10% higher than the similarity between data of bat captures and bat passes within the forest interior and edge sites, respectively.

Population changes in a bat community in the mangrove swamp forests in the Kikori River delta, Papua New Guinea

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Bat communities in the mangrove swamp forests of the Iviri and Keboi Kerowa area in the Kikori River delta were periodically monitored with mist nets between November 1998 and December 2004. A total of 435 individuals of 12 species of bat were captured. *Macroglossus minimus* constituted 90% of captures. The population fluctuated with an almost 11-fold difference between the peak and its lowest point. Bat numbers were correlated with cumulative monthly rainfall residual (CMRR) with a time lag of three (r^2 = 0.63; F=5.82; p<0.05) to four months (r^2 = 0.63; F = 5.89; p<0.05). There was a significant correlation between a subjective bat flower abundance score and the mean captures of *M. minimus* per netting period (r^2=0.64; F=6.255; p<0.05). Flowering peaks on a phenology transect tended to be highly variable between years, but were generally during the drier season. Sixteen opportunistically sampled *M. minimus* were found to be carrying substantial pollen loads of at least six species. Reproductively active females and juvenile *M. minimus* were caught in all netting periods. In general though, a greater proportion of the population were juveniles in the dry season (X^2=15.68; 1df; p<0.001) suggesting that some degree of synchrony in reproduction related to rainfall and food availability may occur. The results of this study suggest that rainfall and abundance of food has an important influence on population dynamics of *M. minimus* over long time periods and that food supply is not stable and predictable even in tropical areas with high rainfall.

Do ephemeral streams in the Pilliga forests support a characteristic bat community?

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Riparian zones potentially provide very important habitat for microbats. In forests subject to logging, buffers are normally retained along streams to maintain water quality and protect riparian vegetation and its associated fauna. In the Pilliga State Forests of north-west NSW, streams are ephemeral ranging in size from shallow depressions to sand rivers more than 80 m across. We sampled bats as part of a broader program to assess biodiversity around ephemeral streams and to investigate: 1. the importance of riparian zones to bats, 2. if there is a distinct bat community along riparian zones, 3. the distance away from streams at which this community changes, and 4. whether this distance varies with stream order. Anabat detectors recorded bat activity over two consecutive nights at each of three stream sizes (small, medium and large), clustered into five different locations (replicates). Anabats were placed at varying distance perpendicular from the dry, stream-bed centre (0 m, 50 m, 100 m, 200 m). To assess the influence on bat activity of the flyway *per se* versus the riparian zone, one cluster of sites represented a control or reference that comprised dirt roads of different sizes. Over the course of the study 20,472 bat calls were recorded from 15 species. A multivariate analysis (nmds) of species composition indicated that there was no distinct bat community characteristic of the riparian zone. Overall, bat activity was weakly influenced by stream size and the perpendicular distance from the stream did not influence activity. However, there was a significant interaction between distance and stream size, with large streams supporting three times more activity over the channels than adjacent woodland. A similar, but non-significant trend was evident for medium streams, but not small streams, which usually lacked a distinct flyway. Similarly for reference sites, the largest road supported more activity directly over the road than adjacent woodland. Thus the higher activity found for some linear flyways was mostly related to the lack of clutter, and to a lesser extent the higher productivity of riparian zones. Responses of individual species will also be examined.

EMERGING DISEASES

A risk assessment of the introduction of Nipah virus to Australia via flying foxes

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Flying foxes (genus *Pteropus*) are the natural hosts of several recently emerged zoonotic viruses of animal and human health significance in Australia and Asia. These include the newly recognised paramyxoviruses Hendra virus and Nipah virus (NiV) (genus *Henipavirus*). Two of the putative natural hosts of NiV (*Pteropus vampyrus* and *P. hypomelanus*) are widespread in the Indomalayan archipelago and parts of New Guinea, where their ranges overlap with two species that occur in Australia (*P. alecto* and *P. conspicillatus*). Further, the clusters of NiV-associated disease which occur almost annually in humans in Bangladesh, with evidence of human-to-human transmission, highlight the need for a thorough understanding of the ecology of henipaviruses. This study aims to establish the geographic distribution of Nipah virus infection and level of contact among flying fox populations in the Australian border regions.

Methods:
(i) targeted serology and virology of flying fox populations using a serum neutralisation test, multiplex microsphere assay and viral RNA detection using realtime PCR;
(ii) molecular genetic investigation of the population structure of *P. alecto* throughout its range in Australia, Papua New Guinea and Indonesia using analysis of mitochondrial DNA sequence data and nuclear DNA polymorphic microsatellite loci;
(iii) satellite telemetry of eight flying foxes in north Queensland, Western Province (PNG) and Timor-Leste.

Preliminary results:
(i) evidence of Nipah or a Nipah-like virus in flying foxes in Timor-Leste;
(ii) the sharing of multiple haplotype lineages of *P. alecto* between Australia and Lesser Sunda Islands with evidence of recent gene flow between regions;
(iii) movement of flying foxes between Australia and New Guinea.

These preliminary results suggest a theoretical risk exists, and indicate the need for further work on the ecology of henipaviruses in the Australasian region.

Hendra virus: ecosystem disruption and disease emergence

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Flying foxes (*Pteropus* spp) have been identified as natural hosts of henipaviruses, a previously unknown group of viruses responsible for fatal disease outbreaks in livestock and/or humans. There are two members of the genus: Hendra virus, first described in 1994 in Australia; and Nipah virus, first described in Malaysia in 1999, and currently causing annual outbreaks of encephalitic disease in humans in Bangladesh. The emergence of these viruses is widely recognised as due to an increased probability of contact between flying foxes and livestock/human populations as a result of land-use, climatic and demographic changes. There is evidence that such changes are altering the structure and dynamics of flying fox populations in Australia, and we contend that a resultant altered pattern of Hendra virus infection in flying foxes increases the probability of spillover events, and determines the spatial and temporal pattern of these events. Specifically, our modelling has shown that increasing fragmentation and isolation of flying fox populations favours larger outbreaks in flying foxes, and thus increased opportunity of exposure and infection of spillover hosts.

Australian bat lyssavirus

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No abstract.

Rabies prevention, and post-exposure management

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Human rabies is a disease transmitted mainly from bites from infected animal species. Dogs in the developing world represent the greatest risk for transmission, although Australia has a lyssavirus present among various bat species. Two human deaths from this Australian Bat Lyssavirus have been recorded. The risk to individual Australians is low, but bat-handlers within Australia, and international travellers are at increased risk. Some occupations, laboratory and research workers who may work with live virus, may be at high risk.

Prevention for individuals involves an understanding of risk and avoidance of vectors, the routine use of post-exposure prophylaxis, and consideration of pre-exposure prophylactic immunisation.

A second rabies vaccine for post-exposure prophylaxis and for pre-exposure immunisation has become available. Australians who work with bats, those who work with rabies virus, and medical practitioners need to be familiar with the preventive strategies and vaccines.

CONSERVATION MANAGEMENT I

Grey-headed flying-foxes in orchards: a collaborative project on damage estimates, contributing factors, and mitigation strategies - triumphs and tribulations of flying-fox conservation and management in NSW

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The grey-headed flying-fox, *Pteropus poliocephalus*, (GHFF) is listed as a threatened species in NSW, Victoria and nationally. The GHFF is a key species in maintaining forest ecosystems through the pollination of native trees and the dispersal of rainforest seeds. This threatened species is unique in that it is also recognised as a horticultural pest, predominantly in coastal orchards of south-eastern Australia. In times of native resource (pollen, nectar and rainforest fruits) shortage, flying-foxes are known to utilise commercial fruit crops. As such, the species is affected by control techniques employed by horticulturists to mitigate flying-fox damage, including shooting and netting.

The NSW Department of Environment and Conservation (DEC) and the NSW Department of Primary Industries - Agriculture (DPI) are working collaboratively to investigate flying-fox damage to commercial crops to assess/quantify the levels of flying-fox damage (temporally and spatially), to determine the factors contributing to trends in crop damage, and to assess the effectiveness of mitigative measures employed by horticulturists to reduce flying-fox damage. The project is funded for two financial years through the Australian Government's Natural Heritage Trust Strategic Reserve funding and State Government contributions (cash and in-kind), and addresses several recovery actions of the draft National Recovery Plan for the GHFF (in preparation). The project proposal was also strongly supported by the NSW Flying-fox Consultative Committee.

The project commenced in October 2006 and focuses on commercial crops in the western Sydney Basin. To date, preliminary trials have been conducted in the Bilpin, Kurrajong and Darkes Forest areas. Parameters currently under investigation include total yield loss, damaged fruit (including that specifically attributable to flying-foxes), flying-fox crop visitation indices, and crop architecture. These parameters will be compared across different stone fruit and apple crop types, and between netted and un-netted crops to examine spatial and temporal trends. The process of establishing and implementing the collaborative project is discussed, within the framework of flying-fox conservation and management in NSW.

Pteropus, pestilence and politics – managing flying foxes in an inane environment

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Managing flying-fox colonies is no less challenging now than ever before but the expectations of the community have risen to an all time high. Colonies of flying foxes seem to find urban campsites more desirable than those in isolated areas and whilst we can't seem to understand the reasoning, we need to look more into integrating information systems that can provide modelling data to assist us in undertaking more accurate assessments of the potential impacts of flying foxes on communities.

Broad community support for the existence of flying foxes is virtually non-existent as the falsehood of the extent of zoonotic diseases is perpetuated and fictionalised into folklore. Government agencies are forced, as a consequence, to deal with the perceptions of the community rather than managing the realities of the issue. Community education programs are ignored in favour of actions and retributions against either the flying fox or the agency responsible for its management.

Is the fruit you eat flying-fox friendly? The effects of orchard electrocution grids on Australian flying-foxes (*Pteropus* spp., Megachiroptera)

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Orchardists have used electrified grids, which kill or injure flying-foxes, to "protect" fruit crops. A 2001 Federal Court judgement prohibited use of one 6.4km grid because it adversely affected World Heritage values. Subsequently, Queensland stopped permitting grid operation – an orchardist's appeal against this was withdrawn before going to court. Two NSW orchardists using a grid, pleaded guilty to cruelty/ aggravated cruelty. Orchardists' responses to these cases, and difficulties in policing grids - many of which remain in working order in Queensland - stimulated this review. It summarises evidence that grids:- are ineffective in preventing damage to crops; do not selectively kill flying-fox "scouts"; will significantly hasten decline of flying-fox populations; do not kill flying-foxes "instantly" but inflict extreme pain and suffering *before* death; injure some animals, which survive in severe pain, and cause pain/ suffering to suckling young via death of mothers. Apropos the *NSW Prevention of Cruelty to Animals Act,* grids cause **(1)** *multiple uncontrolled acts of cruelty*: multiple in that many bats are affected; uncontrolled in that there is no control on the numbers of bats affected; acts of cruelty, in that animals are unreasonably and unjustifiably mutilated, maimed, terrified, exposed to excessive (electrical) heat and inflicted with pain. **(2)** *multiple uncontrolled acts of aggravated cruelty*, in causing death or serious disablement of multiple animals, some being so severely injured that it is cruel to leave them alive. Since exclusion netting is a wholly effective, non-lethal means of protecting crops, electrocution grid operations should be prohibited.

Large-scale re-distribution of spectacled flying-foxes (*Pteropus conspicillatus*) after Tropical Cyclone Larry

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Wildlife responses to major habitat disturbance have rarely been examined at large spatial scales, and available information on flying fox (*Pteropus* spp.) behaviour following cyclonic events is limited to small oceanic islands. Tropical Cyclone Larry, which hit Far North Queensland in March 2006, provided a unique opportunity to examine the impacts of such an event on *Pteropus conspicillatus* population distribution across the Wet Tropics bioregion, as we had collected data over two years pre-cyclone. Here we report on how *P. conspicillatus* re-distributed immediately after the cyclone, and over the subsequent 12 months. Post-cyclone, *P. conspicillatus* were typically found in only small camps until December 2006, nine months after the cyclone, and in certain months during this period up to 90 percent of the pre-cyclone *P. conspicillatus* population (c. 250,000) was unaccounted for at known camp-sites. Calls for public information on flying fox whereabouts assisted us in locating small camps of *P. conspicillatus* at eight 'new' locations, but added little to the overall population estimate. At the time of submission, the *P. conspicillatus* population appeared to be around 150,000; 60 percent of the pre-cyclone estimate. Short- and long-term cyclonic impacts on the *P. conspicillatus* population in Wet Tropics bioregion will be discussed in relation to implications for future conservation and management of this threatened species. Only ongoing data collection will reveal whether the population has declined as a result of the cyclone, or whether the unaccounted population is roosting at yet to be discovered locations.

KEYNOTE ADDRESS

How did you get interested in bats?

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The title of this paper is a question that is frequently asked to all people who work with bats, and one that has been put to me many times since I first became interested in bats in 1960. In this paper I will attempt to answer this question by relating to people and situations in my life that have led to my total devotion to this wonderful group of mammals.

The major influence in my lifetime involvement with bats was joining the CSIRO, Division of Wildlife Research in 1962. It was here that a number of staff fostered my interest and jointly we began recording our early observations on Australian bats. At that time, the list of recognized bat species for Australian was only fifty. This made identification of species very easy for a novice bat researcher. There was a wonderful species called *Eptesicus pumilus* into which all small brown bats were placed. This group of bats now composes the genus *Vespadelus* and currently contains nine species. Studying bats for over forty years has taken me to some interesting places and given me memorable experiences. It has been a very fulfilling and rewarding experience.

A lot has been achieved by the collective efforts of Australian bat workers. However there is still much to learn about their biology and conservation. This is a challenging task and one that can easily become a passion and consume your life.

CONSERVATION MANAGEMENT II

Recent microbat surveys of reserves between the Hunter and the Hawkesbury including Manobalai, northern Wollemi, Yengo and Parr

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Since 2004 the NSW DEC has been undertaking a program to address the gap in biodiversity data on large or inaccessible reserves in the northern half of the Sydney Basin. The project includes systematic fauna survey between the Hawkesbury and the Hunter Rivers, particularly within Yengo and northern Wollemi National Parks, Manobalai Nature Reserve and Parr State Conservation Area. This presentation will summarise the results of the microbat surveys to date. Survey methods implemented are harp trapping, ultrasonic bat call detection and searching for roost sites. Twenty-three species of microbat have been detected so far, with the composition of species differing markedly between reserves. Manobalai is characterised by species typical of the drier western slopes of NSW, such as *Nyctophilus timoriensis* and *Saccolaimus flaviventris*. Northern Wollemi supports a diverse mix of bats including species typical of both coastal and western environments. For example *Scotorepens orion* and *Mormopterus norfolkensis* are present in conjunction with *Scotorepens balstoni* and *Mormopterus* species 3 (short penis form). The higher altitude environments in Central Wollemi have resulted in the greatest number of *Vespadelus darlingtoni* and *Falsistrellus tasmaniensis* captures. Surveys of southern Yengo and Parr are not yet complete, but so far have detected a relatively small number of bat species, dominated by species typical of sandstone coastal hinterlands. The surveys have detected numerous new locations for threatened species, one highlight being the discovery of a maternity roost of *Vespadelus troughtoni*. The data generated by the surveys are informing reserve and threatened species management. In the future the data will be used for habitat modelling and identification of conservation priorities, building on the work recently undertaken by DEC for southern Sydney.

Using habitat modelling to better understand threatened bat species

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Predictive modelling of preferred habitat has been used in the management of fauna for many years. However, most threatened bat species have had too little data for useful models to be generated; and for a number of reasons it has often been considered inappropriate for this group. Here I present some results from a recent habitat modelling project for the Greater Southern Sydney Region of New South Wales. Modelling was based on three years of intensive survey for bats and other vertebrate fauna, combined with previous survey efforts in the region. Habitat maps were effectively created for several threatened bat species.

The success of the modelling project was largely due to comprehensive sampling, along with good quality predictive variables (based on high resolution vegetation mapping). The habitat maps led to interesting revelations about some of our most poorly known bat species, including the Large-eared Pied Bat (*Chalinolobus dwyeri*). Previously, this species was thought to be virtually restricted to the rugged sandstone escarpment country of eastern Australia, and was considered protected by the fact that these environments are well reserved. However, this project has shown that Large-eared Pied Bats are absent from the middle of large expanses of low-fertility sandstone woodland. Rather, they exist on the fringes where they make use of forests on higher-fertility soils and Grassy Box Woodlands. This simultaneous requirement for sandstone overhangs, where the species roosts and breeds, and higher fertility woodlands and forests for foraging may help account for why this species is so patchily distributed across its range.

Nectar maps for Grey-headed flying foxes: describing seasonal dynamics and identifying key habitats

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Complex relationships between the flowering characteristics and distribution of plants in the diet of Grey-headed flying foxes (GHFF) make it difficult to explore the processes that underlie resource dynamics and identify key habitats for conservation. The aims of this project were: to develop a systematic method for evaluating flowering characteristics and distributions using existing data; and to use the method to describe resource dynamics and rank vegetation communities according to their significance for GHFF. Five attributes were used to define the productivity of diet plants, and the annual reliability and duration of flowering events. Data were gathered from a range of sources and collapsed into three or four scores per attribute to accommodate differences in methods of collection. In addition, the seasonal flowering schedules of plants were recorded at bi-monthly intervals. Plant communities described in GIS vegetation models were used to define habitats, calculate the relative densities and distributions of diet plants, explore spatial and temporal patterns at geographic scales and generate nectar maps.

The species richness of diet plants and the extent of feeding habitat for GHFFs decrease along a latitudinal gradient and with increasing distance from the coast. The richness of highly productive plants varies in line with patterns of overall species richness. However, richness of plants with reliable flowering patterns decrease across the gradients at greater rates, generating unreliable feeding landscapes in southern and inland areas. The factors that support seasonal food resources vary. For example, summer-flowering species characteristically show a low degree of reliability, which is apparently compensated for by widespread distributions and high species richness in local areas. By contrast, high levels of reliability and productivity in winter-flowering plants are moderated by low species richness and restricted distributions. These results are in keeping with our understanding of annual patterns of winter concentration and summer dispersal in GHFF and suggest that the extent of nomadism varies between seasons.

Survey of bats on Norfolk Island

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Nothing is known of the bat fauna of Norfolk Island at the time of European discovery and settlement in the late 18th century. The East Coast Freetail Bat (*Mormopterus norfolkensis*) was described from a specimen in 1939. Doubts exist over whether the specimen was actually from Norfolk Island or elsewhere. Gould's Wattled Bat (*Chalinolobus gouldii*) was recorded from the island in 1915.

I undertook an initial survey for bats on the island in February 1986 using harp traps and mistnets. A second survey utilising Anabat detectors at thirty sites for a total of 260 hours of sampling was undertaken in February/March 2003. Sites were distributed throughout the island including residential areas, rural settings and remnant forest. In addition, island residents were questioned regarding their knowledge of bats. The results of the surveys are discussed.

ECOLOGY II

A preliminary analysis of aircraft bat strikes in Australia

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Collision with bats is often considered to represent a significant threat to commercial and military aircraft in Australia, even though specific studies designed to quantify and mitigate these effects have yet to be implemented. Here we report on the first statistical analysis of bat strike records within Australia. Using the Australian Transport Safety Bureau database (which includes records of bat strikes) in combination with the Air Services Australia database (which reports records of movements of aircraft within Australia), we summarize the incidence of bat strikes in Australia, relative to aircraft activity. Preliminary results indicate that time of night (evening vs. early morning) and airport location significantly influence the probability of bat strikes in Australia.

Bats and wind farms: a review of issues and techniques to progress the development of formal assessment guidelines

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Because of the controversial nature of wind farm projects and their potential impact upon threatened bat populations, bat fauna assessments at proposed sites need to involve rigorous study and there is much need for formal guidelines. This paper outlines the *pitfalls, problems and practicalities* experienced by the author at ten of these important developments in NSW, and four in Victoria. The paper provides information on pre-approval survey methods, post-construction monitoring strategies, and reviews recent consent conditions for a wind farm that are likely to set current standards for NSW.
Topics covered include habitat selection patterns at wind farm sites, activity patterns in relation to weather and climate, effect of wind speed on foraging activity, activity in the rotor swept area, methods for targeting migratory species, and our current knowledge of patterns of avoidance and collision. It was concluded that if precise and meticulous studies are conducted, and a series of protocols are developed to address threatened species issues, then wind farms are valuable developments that can help arrest the impact of climate change upon bat populations in general.

The movements of Large Bent-wing Bats *Miniopterus schreibersii* between sites in the Eastern Suburbs of Sydney

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Large Bent-wing bats have been recorded roosting in a variety of man-made structures in Sydney (Hoye and Spence 2004). These structures include disused buildings, railway tunnels, stormwater culverts and military installations. The bats roost in these sites during the summer months and desert the sites in winter, only to return the following spring.

In 2003, a new roosting site was discovered at Malabar in Sydney's eastern suburbs. This site was close to another known roosting site at La Perouse (Henry Head). Monitoring results over the next 2 and a half years found that the bats moved between these two sites in response to wind strength and humidity. The bats moved away from the more exposed sites (at Cape Banks and Henry Head) during windy weather and sheltered in the less exposed roosting site at Malabar. After heavy rain, the Malabar site became partially flooded and the humidity in the roost remained high for four months; during this period the bats avoided this roost even though it was the most protected site during strong winds. Roost site air temperature did not appear to be causative factor in roost site selection.

Defining conservation issues for hollow-using bats in inland ironbark and mixed species eucalypt forests: an example from the Pilliga forests of NSW

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Current threats to bat species in the Pilliga include a), loss of tree hollows, and future recruit trees for hollow formation; b), climatically induced changes to fire regimes; c), perceptions of tree longevity and confusion about the pre-European condition of Pilliga forests; d), the imperatives of extractive industries; and e), lack of baseline research. Past removal of the majority of the hollow resource from forestry activities and fire has resulted in tree age classes that are highly skewed toward very young or very old trees over most of the forest estate. Without management intervention, a critical shortage of hollows is anticipated until at least 2300 AD, based on estimates of tree longevity and lead times for hollow formation for slow growing inland hardwoods. Given this, restorative management actions have considerable merit. It is concluded that all species of hollow-using bats could face impending population declines and many species could face regional extinctions in the coming decades. Management issues and threats to hollow-using bat species in the Pilliga forests are common to similar forests that extend from south-east Queensland to Victoria.

Bat research in Mumbulla State Forest since 1980

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There has been much progress in bat biology in the last 27 years since we initiated our research into the effects of woodchipping on the bats of Mumbulla SF in 1980. Most striking has been the improvement in trapping techniques (especially the collapsible harp trap), the decrease in the weight of transmitters to about 0.5 g so that more species can now be tracked to roosts, and the invention and refinement of Anabat, especially the new Zcaim for recording only bat calls. Some powerful limitations remain for bat biologists in forests: the harp trap is largely limited to a few species; radiotracking bats, especially with small transmitters, remains hard and slow; and Anabat, like all acoustic systems, cannot differentiate between the sexes, and cannot count individuals, only the number of sound records, and some common species cannot be separated, e.g. among the *Nyctophilus*. We also note that the ability to distinguish between species in the hand remains problematic. This is exacerbated by weak funding support for unravelling the taxonomic confusion of bat species, which in turn complicates call identification. One consequence is that any estimates of population size of any species of forest bats remain out of reach. We are also unable to define foraging habitat. Since we do not know what bats are doing as they fly through the forest, then many elements of an experimental approach to ecology are just that much harder to implement. Nevertheless, we can conclude that the research has contributed much to conserving both bats and forests, particularly the recognition of the critical importance of the old growth trees as roosts. We also regard it as important to record that the generous exchange of ideas and equipment among bat researchers has contributed greatly to our endeavours in this forest, and to bat conservation in general. This bat conference is another example of that willingness to work collectively for the common good of bat conservation.

REPRODUCTION AND POPULATION STRUCTURE

Genomic and epigenetic regulation of flying-fox reproduction

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Timing of seasonal reproduction by flying-foxes is apparently dependent on an endogenous circannual rhythm, coded in their genome. Ultimately, evolution of an endogenous rhythm aligns an important reproductive stage, such as lactation, with resource availability such as the occurrence of maximum plant productivity; animals then do not have to rely on proximate factors to predict conditions nine months in advance. External influences that re-align reproduction to match a phase-shift in environmental conditions have to either adjust the period of the biological clock, or else induce a phase-shift, to bring breeding back into line with prevailing conditions. These are epigenetic factors: they influence the expression of genes without altering the DNA.

Stages of reproduction relate temporally with the endogenous rhythm, but individual flying-foxes may need to make fine adjustments in their own timing. To do this they probably monitor a suite of environmental conditions. It has been proposed that if a signal changed in isolation from other factors it would be ignored. For example, it is important that a nomadic species be not directly responsive to photoperiod since this differs when they move between latitudes. A reproductive stage would, however, be inhibited if several cues warned against proceeding, e.g. inadequate forage combined with long commuting distances at a time of unfavourable temperatures.

What epigenetic factors regulate flying-fox reproduction? It is likely that rainfall is part of the regulation for the overall rhythm, while current energy balance is probably important for individual animals during many stages of their reproduction.

The novel reproductive biology of the female flying-fox and its implications for the successful development of artificial insemination

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Artificial insemination (AI) has the potential to play a primary role in the conservation of endangered flying-foxes, through the genetic and reproductive management of captive colonies. Semen from surviving wild populations, or from separate captive colonies, can be utilised to maintain genetic vigour, thus preventing in-breeding in potential seed populations that can then be returned to restored habitat. The development of AI technology in flying-foxes has been hampered by the atypical reproductive biology of female Megachiropterans. Pteropids have a duplex uterus, with separate cervices, and a well-defined ovarian vascular complex that provides a counter-current exchange system between the ovary and ipsilateral uterine horn. This arrangement reduces systemic circulation of steroid reproductive hormones and makes it difficult to accurately characterise the endocrinology of the oestrous cycle; it is also consistent with the apparent lack of overt behavioural oestrus in these species. Low concentrations of peripheral oestradiol also mean that vaginal cytology is not a strong correlate of reproductive status. If AI is to be utilised as a conservation strategy in flying-foxes it is vital that an accurate method of oestrus detection be established. The integrated examination of plasma hormones, behaviour and vaginal cytology, following direct hormonal stimulation of folliculogenesis in the ovaries, may improve the signal to noise ratio in this subtle physiological system. Such improved sensitivity may make it possible to develop an accurate method of oestrus detection. Development of the remaining steps in AI may then proceed.

A hundred-and-forty days in the life of a flying-fox tooth-fairy: estimating the age of pups using tooth eruption and replacement

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Age can be an important predictor of an individual's survival or reproductive fate and therefore methods for determining ages of wild animals are of general interest. Bats are assigned to age classes based on morphological measurements (e.g. forearm measurement and tooth wear); or to a chronological year based on annual cementum rings in teeth. However, for infants, only morphometric techniques are available, and individual variation can lead to less reliable predictions of age from these measurements. Here we describe the sequences and timing of tooth emergence and replacement in the Grey-headed flying-fox (*Pteropus poliocephalus*) and evaluate the usefulness of the method for ageing pups.

Tooth eruption and replacement were assessed visually and at least 4 stages of growth were described for each permanent tooth for 27 known-age, mother-reared pups (18 in 2005/2006 and 9 in 2006/2007) that were monitored weekly (October – February). Forearm measurements and mass were also recorded. To test the reliability of the method we also aged 30 additional pups. The ages derived from tooth eruption were compared to ages derived from the traditional method using forearm and weight measurements. Our results indicate that the tooth eruption technique is more reliable in estimating flying-fox age up to 140 days-old. Further research should compare rates and patterns of tooth eruption in hand-raised to mother-raised pups and use a larger sample size to look for any gender differences. Accurate ages for pups will contribute to determining the age-specific mortality rates for this vulnerable species.

A genetic perspective on the spectacled flying-fox, *Pteropus conspicillatus*

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The spectacled flying-fox (*Pteropus conspicillatus*) was listed as vulnerable under the EPBC Act in 2002, even though the Action Plan for Australian Bats stated that there was insufficient knowledge on this species to accurately assess its status. To aid in the effective management of the spectacled flying fox a genetic and demographic study was undertaken to supply baseline information derived from population genetic structure, genetic diversity, gene flow, relatedness within colonies, population age structure and movement patterns. Here, we present the results from genetic analyses conducted on samples obtained from across the majority of the range of the spectacled flying fox.

Samples consisted of a small amount of wing membrane that came from animals from a variety of sources including many that had died from tick paralysis on the Atherton Tablelands. As expected, colonies within the Wet Tropics World Heritage Area can be considered a single panmictic population. However, while there has been movement between colonies in the Wet Tropics, Iron Range and Papua New Guinea in the past, the data indicates that there have been periods of isolation, such as appears to be occurring currently.

Calculation of genetic relatedness based on the multilocus genotypes among individuals within Powley Rd colony suggested that groups of closely related individuals could be found together in the same colony, with the group often consisting of several older females, young from that year, and immature sub-adults from previous years. This suggests sub-adults may stay with their mothers for several years, learning the location of important foraging places across time and space. Genetic analysis has allowed a different perspective on the biology of these important animals.

POSTERS

The impact of the drought on bats

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Naracoorte Caves' population of southern bent-winged bats *Miniopterus schreibersii bassanii*, has been the subject of many years research. One facet of this research has been determining the population and how stable this is, after a significant decline was observed to have occurred between the 1965 estimate of over 100,000 and the 2000 count of 35,000. Investigations into possible causes have included chemical use in primary industry and changing land use in the region.

The bats and their daily activities are observed and interpreted to visitors using infra red technology transmitting images from Bat Cave to the Bat Observation Centre. Visits into the cave for camera maintenance and cleaning are the only non research visits. It was one of these camera cleaning visits that the impacts of the dry and cold season on the bat nursery were first observed.
The nursery was established in a part of the cave not readily visible using the cameras. On a visit to the cave on 7 December, over 300 were counted dead or dying on the floor and dozens more were still hanging from the ceiling in an emaciated condition. Follow up visits were made on 14 December when significant numbers were still dying and then on 30 December, by which time the situation appeared normal.

It is suggested the reason for the early deaths is likely to be the lack of insects brought about by the extremely dry conditions through winter and spring. This was further compounded by the record number of cold nights that further restricted insect activity at a critical time. This poster presents the impacts on the unseasonable conditions on the Bat Cave population and links the weather observations with the observations from within the cave. It is suggested that continuing weather patterns of this nature will place the population at severe risk of further decline.

Transmigrating pteropids: International movements of flying-foxes – implications for conservation and introduction of disease

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Human activities appear to be causing significant changes in flying fox distribution and behaviour, bringing them into closer contact with domestic animals and people. Flying foxes are reservoir hosts for several recently emerged fatal zoonoses including Nipah virus (NiV), Hendra virus and Australian bat lyssavirus. NiV is exotic to Australia but present in southern and southeast Asia. The level of contact among flying fox populations in Australia, New Guinea and southeast Asia is currently unknown.

The aim of this study was to track the long distance movements of flying foxes in Australia's border regions as part of a broader project to assess the risk of the introduction of NiV to Australia via flying foxes.

Satellite transmitters were placed on eight flying foxes (4 *Pteropus alecto*, 2 *P. vampyrus* and 2 *P. neohibernicus*) and their movements tracked for a total of 150 weeks. Six movements across political and putative ecological boundaries were made by the flying foxes. *P. alecto* moved between Australia and Papua New Guinea on four occasions, and between Papua New Guinea and Indonesian Papua on one occasion. *P. vampyrus* moved from Timor-Leste to Indonesian West Timor on one occasion. These results suggest a contiguous population of *P. alecto* exists in parts of north Queensland, Western Province (PNG) and Papua (Indonesia). This highlights the potential for close connectivity between flying fox populations on the Australian and New Guinean land masses and associated political regions and hence the importance of international cooperation in disease risk management and conservation planning.

Studies on damage caused by Grey-Headed Flying-foxes (GHFF) and factors affecting their influx into fruit orchards in the Sydney Basin

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A collaborative project to determine the economic losses in orchards caused by Grey-headed flying foxes (GHFF) and the internal and external factors of the orchards and GHFF behaviour affecting the damage levels has commenced in the Sydney Basin. The study is funded by Australian Government Natural Heritage Trust (NHT) Strategic Reserve funding, NSW Department of Environment Conservation (DEC) cash and in-kind contributions, and NSW Department of Primary Industries (DPI) in-kind contributions, and addresses several recovery actions of the draft National Recovery Plan for the GHFF. The project was also strongly supported by the NSW Flying-fox Consultative Committee.

Preliminary assessments conducted in orchards in Bilpin and the Southern Highlands indicate that GHFF could cause significant yield loss in orchards without netting. In another trial, fruit loss caused by GHFF removal of fruit and damage of fruit on trees was monitored before harvest. Up to10% of fruits were taken away and 3% of fruit were damaged during the three week period. Estimates of damage during harvest are ongoing. Surveys of GHFF visiting orchards were conducted from early November 2006 to February 2007. Results show that there was significant difference between flying-fox activity in different regions in the Sydney Basin: Kurajong and the Southern Highlands had lower GHFF activity than Bilpin and Glenorie.

Continuing work will determine the cost-effectiveness of netting as a strategy to control GHFF damage in orchards. The contribution of orchard design and location variables, and external factors to damage experienced in orchards will be modelled.

'Bats In Your Backyard' project: a baseline monitoring project for the Northern and Yorke Region of South Australia

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'Bats in Your Backyard" is a new project being managed by the SA Department for Environment and Heritage (DEH) in Clare. The project has been developed to collect baseline data on the presence and distribution of microbats across the Northern and Yorke Region. Data will be collected using Harp trap and Anabat equipment.

The Northern and Yorke Region of South Australia covers the State’s Mid North, Flinders and Yorke Peninsula districts, an area of some 9,800,000 hectares. There has been extensive clearance of vegetation across the Region, primarily for agricultural production. The remaining native vegetation is generally comprised of relatively small patches, within a highly fragmented landscape. The impact of habitat loss and modification on local microbat species is not well understood.

The project was developed in 2006 with input of staff from DEH, the Northern and Yorke NRM Board, and SA Museum. The project will initially focus on the determining the distribution of microbats across the Region and an examination of what natural and artificial habitats are being utilised. Once baseline data has been collected, an assessment of the effects of habitat loss and fragmentation on the local microbat fauna will be undertaken.

There is strong community support for the project. Local community groups, community members, and landholders will be involved in the collection of data. This will provide a strong base upon which conservation initiatives can be developed.

Roosting and social behaviour of the east coast free-tailed bat *Mormopterus norfolkensis* in eastern New South Wales

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The east coast free-tailed bat is a poorly known bat species occurring largely coastally from southern New South Wales to south eastern Queensland. Little is known of its roost preferences, social behaviour, reproductive strategies or diet. Within its range it has been captured sporadically, but has been more commonly recorded from echolocation calls in the last two decades.

Individuals of the East Coast Freetail Bat were radio tracked to diurnal roosts at two sites in eastern New South Wales when individuals became available through targeted capture or through roost disturbance. Characteristics of identified roost trees were noted together with their placement in the landscape. At one of the sites this species has utilised artificial roost boxes for the past seven years. This has allowed some aspects of social structure to be recorded during regular inspections of the boxes.

Grey-headed flying-foxes drinking

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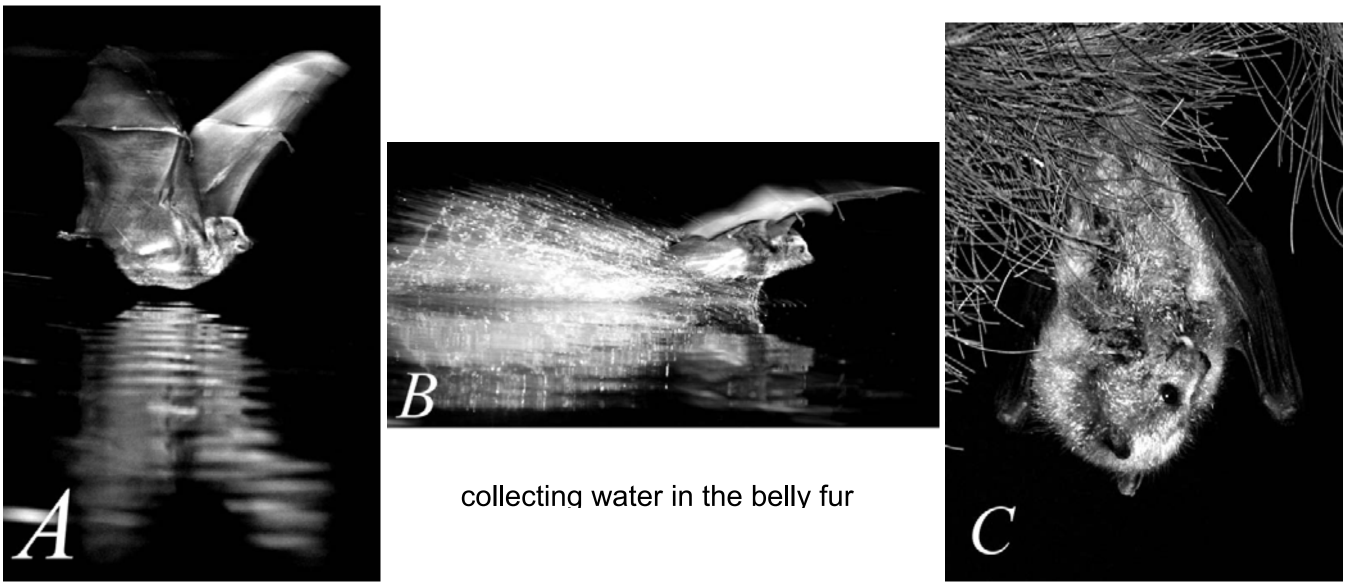

collecting water in the belly fur

drinking

Preliminary analysis of micro-bat surveys of Cumberland Plain reserves

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Microchiroptera were surveyed with harp traps and Anabat system at 191 sites in reserves on/adjacent to the Cumberland Plain, western Sydney. 647 individuals were trapped and 2069 echolocation sequences were recorded of 16 species. The two most commonly caught species were *Vespadelus vulturnus* (31%) and *Nyctophilus geoffroyi* (26%). The species recorded at the most sites with Anabat were *Chalinolobus gouldii* (54%), *V. vulturnus* (45%), *Mormopterus* sp. 2 (34%), and *M. norfolkensis* (32%). The latter two species were infrequently captured. The overall mean number of captures per trap night was low (1.33±0.19; range 0–22). The mean number of species/site was 1.27±0.09 (trapping: range 0–7) and 2.67±0.15 (Anabat: range 0–9). The sex ratio was female biased at Agnes Banks NR (X^2 = 7.48; 1df; P<0.01), Castlereagh NR (X^2= 13.32; 1df; P<0.01), and Cattai NP (X^2 = 8.27; 1df; P<0.01). All of these reserves have many old hollow-bearing trees and relatively large intact bushland adjacent. For the two most common bats there was no difference in the weight and condition of adult males between reserves, suggesting that poorer quality habitats do not have animals in poorer condition. There was a significant correlation between the mean number of species/site and vegetation within 3km (r^2 = 0.43; F = 7.363; P<0.05), and the mean number of individuals/site and vegetation within 3km (r^2 = 0.58; F= 13.9; P< 0.01). This has long term implications for western Sydney's micro-bat populations as further urban development occurs. This study suggests that whilst western Sydney reserves still support a diverse micro-bat fauna, the fate of these bat populations is by no means secure.

Echolocation calls of eight microchiroptera from Papua New Guinea

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The bat fauna of Papua New Guinea (PNG) is more diverse than that of Australia yet knowledge of the distribution and ecology of PNG's 57 microchiropteran species is particularly poor, almost a third being known from five or less localities. The lack of knowledge is partly due to problems with use of both mist nets and harp traps in PNG. Bat detectors may help overcome some of these problems however they have not been widely used in PNG primarily due to the lack of a body of reference calls to aid species identification. We recorded 744 reference echolocation call sequences from eight microchiropteran species captured in PNG using the Anabat system. Calls were analysed using Analook software and described. The characteristic frequency of the predominant harmonics were: *Aselliscus tricuspidatus* 112 – 113 kHz; *Hipposideros cervinus* 136.5 – 138 kHz; *H. diadema* 54 – 59 kHz; *H. maggietaylorae* 121 – 123 kHz; *Mormopterus* cf *beccarii* 44 – 50 kHz; *Mosia nigrescens* 45 – 60 kHz; *Rhinolophus arcuatus* 70 – 72 kHz; and *R. euryotis* 52 – 56 kHz. Comparison with published calls of some of these species from Australia, southeast Asia and elsewhere in PNG suggest regional variations occur within PNG and abroad and/or that there are taxonomic issues such as cryptic species. This emphasises the need for the development of regional PNG call libraries with vouchered specimens and cautions against using reference libraries developed in Australia or elsewhere. We hope this research will stimulate researchers to begin collecting reference echolocation calls of PNG bats, as the use of bat detectors in PNG would undoubtedly increase the known distribution of many species.

Murray Region Community Bat Monitoring Program

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The Mid Murray Local Action Planning Committee (Mid Murray LAP) has been part of the community bat monitoring program, Bats for Biodiversity, since 2003. Bats for Biodiversity began as a community project known as Batwatch, started in 2001 and based in the Mt. Lofty Ranges. The project involved community members taking an Anabat home for the night to record the species on their properties. The Batwatch program was the first of its kind in Australia. In 2004, the Upper River Torrens Landcare Group and the Mt Pleasant Natural Resource Centre received an Australian Government Envirofund grant to allow Batwatch to grow and develop into the Bats for Biodiversity program it is today. The grant helped these groups to coordinate the bat monitoring occurring throughout the region and to produce a manual to standardize the monitoring process. Information sheets were also produced to encourage local landholders to conserve and improve bat habitat.

The Mid Murray LAP's role within the bat monitoring program has grown since their first involvement. It began with the purchase of an Anabat recorder in 2004 that was loaned to landholders in the Murray region. These recordings were analysed by Mount Pleasant Natural Resource Centre and then sent to the South Australian Museum for confirmation and storage on their database. In 2005 the Mid Murray LAP purchased a further two Anabat recorders as public interest in the program increased. An Implementation Officer was employed with funds from the South Australian Murray Darling Basin Natural Resource Management Board, Community Grants, to continue the bat monitoring program and was trained to analyse data. Today, the Mid Murray LAP has a significant number of participants in their bat monitoring program, while still being involved with the Bats for Biodiversity program. The Mid Murray LAP has also been involved with the installation of the first permanent monitoring station, at Cambrai Area School's farm Meldanda. They have also successfully secured funds to coordinate Cambrai Area Schools bat monitoring program as well as continuing the Mid Murray bat monitoring.

The future is looking very bright for the Mid Murray LAP's community bat monitoring program as it continues to expand. The plans for the future include the installation of other permanent monitoring stations throughout the region, including one at Devon Downs, where colonies of cave dwelling Large-footed Myotis live. A poster of South Australia's Murray Valleys bats has also been produced. The involvement of community members will continue to have a large role in the monitoring program, as the Anabats will make their way around the region. An additional focus of recording reference calls for the area will also be explored to establish a key for the region.

Priority Actions Statement (PAS) for threatened bats in NSW

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In 2006, DEC NSW released a draft document, entitled "Introducing the Threatened Species Priorities Action Statement (PAS)". It presents a new approach to planning for threatened species recovery. The intent of the PAS is to identify the key strategies and detailed priority actions required to achieve recovery and threat abatement. Over 300 of these actions apply to threatened NSW bats of which the key strategies are habitat management, survey, monitoring and further research. These actions highlight the importance of bridging the gaps in knowledge for these species so managers can facilitate recovery on the ground.

This paper presents the PAS as it has been constructed to date. We harbour no illusions that there is much to do, and that the PAS reflects a focus only on the listed bats, and not the full spectrum of species, many of which are threatened by the continuing loss of habitat, and now the added impost of climate change. The PAS is a step that will be seen as historically important because it lists actions, with some background information, hence its presentation here in full for others to comment upon, improve and act upon. For further information (http://www.nationalparks.nsw.gov.au/pdfs/pas0610.pdf accessed 5 march 2007), and more details can be seen on http://www.threatenedspecies.environment.nsw.gov.au/index.aspx accessed 5 March 2007).

Blind to bats

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In our experience as bat researchers over the last quarter of a century, we have been struck by the lack of coverage of bats (especially microchiropterans) in the media. The little coverage there is has primarily been periodic expressions of fear and loathing of flying-foxes in local newspapers in districts where they occur. We found almost no mention of bats in the mainstream press. There is more to be found on the internet, however, for bats, this search mechanism is haphazard and lacks quality control. We did find that bats can be a tourist attraction. Our conclusion is that the public is blind to bats, and therefore to the issues surrounding their conservation and management.

wildlifefriendlyfencing.com

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Thousands of animals each year face a cruel death from entanglement on barbed wire. More than 60 species have been recorded, but flying foxes are affected more than any other, and entanglements are the number one reason for calls to Australian bat rescue organizations.

Tolga Bat Hospital has received a Threatened Species Network grant through WWF, using the Spectacled and Grey-headed flying foxes as its flagship species. Entanglement is considered a threat in the Recovery Plans for these two species. Funding has also come from Bat Conservation International and RSPCA Queensland, and we are waiting to hear from several more.

The wildlife-friendly fencing (WFF) project will address the issue of barbed wire entanglement as a major welfare and conservation problem in Australia, particularly for bats, gliders, raptors and cranes. The intent of the project is to kickstart a coordinated process by wildlife groups, NRM groups, governments and others to deal strategically with the problem. The website www.wildlifefriendlyfencing.com is the focus for information on the project, though by mid 2007 we will have stickers, posters and brochures.

The project is raising awareness of the issue, and working with landowners when wildlife are rescued from fences. We are developing WFF guidelines and strategies, and hoping to make these a condition of any receipt of public monies for fencing. We need to gather data on the extent of the problem and various aspects of entanglement including the outcome for the animal – we have forms on the website that can be filled in for this. Watch the project develop from the website!

Investigation of the success of artificial roosts for *Myotis macropus* at Koala Beach NSW

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In 1997 compensatory roost sites for microchiropteran bat species, *Myotis macropus* were incorporated into the bridge design for a new concrete bridge on the Tweed Coast of NSW. This arose as a result of recommendations from the Fauna Impact Statement (FIS) and requirements for a NPWS section 120 License as part of the development application approval.

Myotis macropus is a vulnerable species listed on Schedule 2 of the Threatened Species Conservation Act, 1995. *M. macropus* seldom occur far from suitable water bodies. Roosts include caves, mines, tunnels, under bridges and buildings and in dense foliage in tropical areas. They tend to inhabit disturbed or human-constructed sites that are likely to deteriorate hence the need to consider their habitat requirements when constructing new infrastructure. Lack of detailed data on the specific roost configurations and roost microclimate for *M. macropus* meant that a diversity of roost types had to be used to maximize the potential utility of the artificial roosts. Twenty-nine artificial roots using four distinct designs were constructed and attached at various angles and positions beneath the concrete bridge. The artificial roosts were located to minimise human access, orientation was varied to cover diverse roost environment, thus creating a greater chance of occupation by bats. The range of positions for each roost design varied according to orientation to stream flow, distance from edge (as opposed to end) of bridge and north verses southern edge in relation to possible differences in shading and sun exposure.

Few studies have investigated the effectiveness of artificial roosts over extended time periods. Such research provides valuable information on the success of the compensatory measures employed and their significance in the conservation of fauna species (particularly *M. macropus* in this instance) and viability for future projects. Compensatory habitat and fauna mitigation measures are increasingly becoming an integral part of development particularly in coastal regions such as the Tweed Shire, which have such uniquely high biodiversity. The artificial boxes have been monitored since 1997, ten years after the new bridge was built the boxes erected provide conclusive evidence that given the right micro and macro conditions, artificial boxes can be successfully incorporated into new bridge design and provide artificial habitat for threatened bat species.

Smile and the world smiles with you or complain and get more attention!

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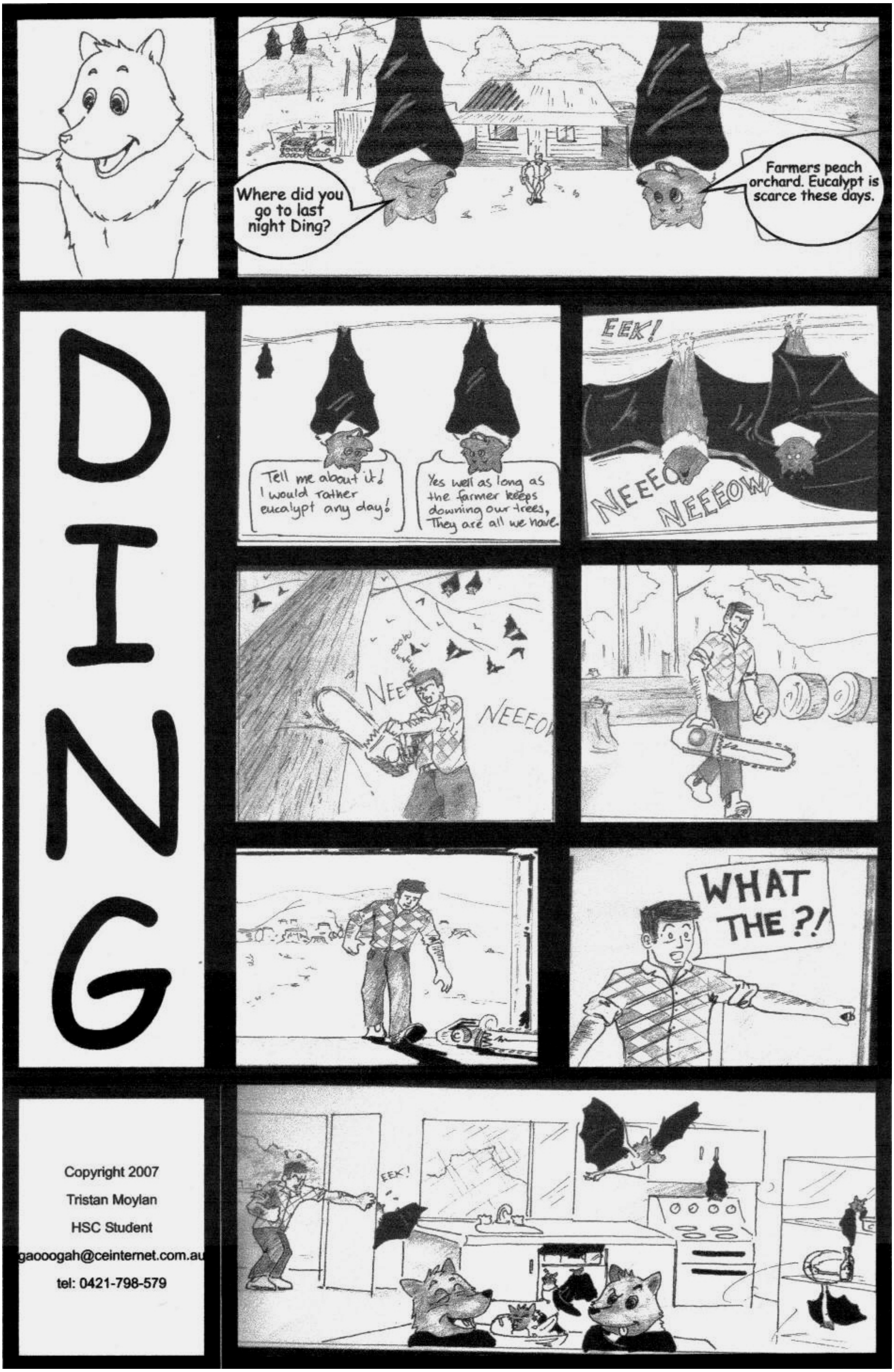
Grey-headed flying-foxes are an important part of our environment, however society has complained and deemed them as a problem and pest. Grey-headed flying-foxes are portrayed in a negative light. There is a need for these important and threatened species to be portrayed in a positive way. I am currently studying Design and Technology as part of my HSC, and for my Major Design Project I have chosen to base it on the positive portrayal of Grey-headed flying-foxes. I have created a promotional cartoon character that can be appealing to a wide variety of audiences, as I would like the world to smile with me. My poster design incorporates my Grey Headed Fruit Bat character in part of a comic strip. The comic strip acknowledges the issue of the fruit bat's habitat being destroyed by humans and their migration into urban society.

(*Ed: Tristan's poster is reproduced on the next page*.)


DING
Where did you go to last night Ding?
Farmers peach orchard. Eucalypt is scarce these days.
Tell me about it! I would rather eucalypt any day!
Yes well as long as the farmer keeps downing our trees, They are all we have.
EEK!
NEEEOW
WHAT THE ?!
EEK!
Copyright 2007
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Alimentary canal is optimised for the flight and inverse posture of *Pteropus scapulatus*, the little red flying-fox (Megachiroptera)

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Flying-fox biology is remarkable in many respects, including how quickly ingesta becomes excreta, how wet and unformed that excreta is, and how the gut motility between ingestion and excretion proceeds against gravity. Special stomach morphology observed in *Pteropus scapulatus*, the little red flying-fox (suborder Megachiroptera) probably helps to localise heavy gut contents close to the animal's centre of gravity. The anchoring of the rectum parallel to the spine also appears ergonomically favourable for flight. Processing in the mouth greatly reduces the time food needs to be retained in the stomach. The morphological arrangement of the ileo-colic junction implies a functional ileo-colic valve mechanism even if it is not structurally well defined.

Overall, the digestive tract of *P. scapulatus* is well suited to ingesta that arrives in semi-liquid form, in pulsed feeding bouts; and to digesta that is processed rapidly, and to excreta that removes excess water with the waste digesta. Form and function are optimised.

"Diverse Weights and Diverse Measures" Glitches in ageing juvenile grey-headed flying-foxes (*Pteropus poliocephalus*)

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Grey-headed Flying-foxes, *Pteropus poliocephalus* are considered Vulnerable under both State and Federal legislation. However very little is known about the life history of this animal in the wild and central to determining the population dynamics of *P. poliocephalus* is the need to age wild animals accurately.

Traditionally, juvenile *P. poliocephalus* are aged by comparing their forearm measurements and weights, to scales based on the growth rates of known-aged captive animals. In this paper this method's reliability is assessed by investigating 10 years of data collected by the Wildlife Animal Rescue and Care Society, a rehabilitation organisation in NSW. This data consist of weekly weights and forearm measurements for both orphan flying-foxes that had been hand-reared and mother-reared animals that had been born to captive flying-foxes over periods in which the diet varied for both adults and hand-reared juveniles.

Forearm size is a more reliable indicator of age than weight. However the growth of the forearm is not uniform from animal to animal as both inheritance and diet cause variations in the rate of growth. Neither forearm length nor weight gives an accurate assessment of the age of a juvenile *P. poliocephalus* and other methods of ageing should be investigated.

Aerial photography and digital image analysis: New techniques for monitoring problematic flying fox camps

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Monitoring Flying fox populations and their seasonal variations can be challenging, particularly in regional and remote camps that are located in difficult and dangerous terrain (due to impenetrable mangrove thickets, thick mud and the presence of estuarine crocodiles). Here we evaluate the utility of aerial photography and image analysis techniques, to monitor camps of *Pteropus alecto* and *P. scapulatus* in the Townsville region. Image analysis software such as Image Tool and Adobe Photoshop provide a rapid and repeatable method of identifying and counting individual flying foxes in photographs. This technique provides a safe, relatively rapid and non-invasive method for monitoring flying fox camps, and is particularly suitable for the study of camps that are remote and/or difficult to access.

Determination of the minimum bat sample group size to provide reliable parasite indices

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Characterization of a whole population based on sample groups will always have a representation error, which will change with growth of the sample group size. At a certain point it will be negligible and with further examinations beyond that point the error remains practically unchanged. A graphic method is proposed to identify that point, determining the minimum size of the bat sample group needed to provide reliable parasite indices. Calculations with various numbers of microbat hosts and subsequent visualizations have shown that to obtain a reliable Abundance Index of bat fleas *(Siphonaptera, Ischnopsyllidae)* or bat flies *(Diptera, Nycteribiidae)* in winter-spring season only 35-40 bats should be examined. In summer, with many young animals in populations, the number of examinations should be increased up to 50-55. Similar results are obtained for the Infestation Index. Examination of only the necessary number of hosts allows minimization of disturbance and stress levels to animals, as well as time and amount of field work, without negative impact on the data reliability. This is especially important while dealing with rare and endangered species as the biological value of each animal and each specimen is incomparably higher.

Human – flying fox conflicts: Are relocations the answer?

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Managing flying-fox camps has become an increasing challenge for agencies responsible for managing wildlife, and for communities along the east coast of Australia. Conflict arises between humans and flying-foxes as a result of flying-fox camp sites being located adjacent to, or within, urban and peri-urban areas. In many cases, members of the public immediately propose that the camp should be relocated. This poster examines the consequences of attempts to relocate the flying-fox camp at Maclean, northern NSW. In 1999, a co-ordinated disturbance commenced aimed at ensuring flying-foxes did not roost adjacent the school in the township of Maclean. This camp was a regularly used, maternity site that had been occupied by flying-foxes for over 100 years. Since the disturbance there have been over 20 attempts by flying-foxes to re-establish the Maclean camp site. Initially the disturbance fragmented the colony throughout the town and flying-foxes made regular attempts to return to their traditional site. The number of attempts has since progressively declined, but flying-foxes are still returning to the site six and a half years after the initial relocation (last attempt October 2005). The total cost of the relocation is at least $750,000 and is ongoing, this includes about 600 person-hours. Since the initial disturbance at least thirteen alternative sites have been used by flying-foxes across the district. Twelve have been used temporarily and irregularly. In addition, in 2004 a continuously occupied camp was established in the Iluka township. It is highly probable that the flying-foxes from Maclean have relocated to Iluka. Residents of Iluka now wish to relocate this flying-fox colony. The experience at Maclean raises the question of how the success of relocations should be defined, and at what spatial scale success should be assessed.

Microclimate preferences of grey-headed flying-foxes

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The grey-headed flying-fox (GHFF) (*Pteropus poliocephalus*) is a highly social species spending much of its time in roosting camps that can be comprised of tens of thousands of individuals. Currently camp site selection of GHFF is an enigma and although there have been a number of studies attempting to identify camp characteristics, it is not understood why certain locations are favoured over others.

Given the lack of knowledge on this topic, I have initiated a study aimed at determining the micro-climate preferences of roosting GHFF in five camps in greater Sydney. At each camp I will record microclimate variables (wind speed, temperature, humidity, solar irradiation) at 10 locations within occupied trees and contrast them with 10 similar locations around the camp perimeter using remote sensors and data loggers. Behavioural observations of the GHFFs will occur in concert with the logging of environmental data to determine how GHFFs cope with varying climatic challenges.

The results of the study have the potential to feed directly into management of flying fox camps not just within suburban Sydney but throughout the species distribution.

Monitoring of a maternity colony of white-striped free-tailed bats (*Tadarida australis*)

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A known maternity colony of White-striped free-tailed bats (*Tadarida australis*) within a building was monitored with video recording and anabat call recording over a period of four months (Dec 05 – March 06). The presence of a maternity colony of this species in a building is of high significance, as roosting in buildings has not been previously recorded for this species, and known locations of maternity colonies of this species within Sydney are limited.

Monitoring was able to assess the initial size of the maternity colony in the building and the increase in population numbers from 26 to 44 individuals over the breeding season, an increase of ≥18 individuals. A few photographs of young bats present in the roost were also taken.

Unusual vocalization behaviour for this species was also recorded. This call variation has previously been noted by Monika Rhodes. The variations in calls included a ‘melodic’ undulating type call and a steep, high frequency FM call. These call variations are yet to be described in detail, and the role of these calls is still to be determined, but some at least, are considered likely to be social calls.

Monitoring of this colony is ongoing, and further techniques will be utilised to gain a better understanding of the behaviour of this species. An update on findings from the recent monitoring will also be presented.

Design components for a bat flyway through Sydney

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Microbats are often limited in their flight paths in urban areas. Street lighting, noise, wind exposure and inadequate tree cover often prevent smaller bats from moving between potential feeding areas. In 2004 and 2005, a bat survey of the Willoughby Local Government Area (LGA) was carried out on a street by street basis. From this data, regular bat movements were recorded and existing major bat flyways determined. In general, two major flyways were present in the Willoughby LGA, the first was along the Lane Cove River Corridor in the western section of the LGA, the other was along the Middle Harbour foreshore in the eastern section of the LGA. Small microbats did not seem able to cross the Pacific Highway rise to move between these major flyways.

The Willoughby LGA was then surveyed on foot to determine if a microbat flyway could be constructed across the LGA from east to west, linking the two major flyways. To do this, the flyway would have to cross urban areas, the northern rail corridor and the Pacific Highway commercial district. A potential flyway was chosen on the basis of the existing and potential street tree cover. The rail and highway crossing would entail the construction of a darkened, wind-shielded overpass; the access and departure points for the overpass would also be darkened and surrounding street lighting altered to make the overpass more conducive to bat movements.

In-flight photograph of a yellow-bellied sheathtail bat *Saccolaimus flaviventris* by Terry Reardon, using the set-up described on page 61.

SUMMARY OF THE PLENARY SESSION OF THE RZS/ABS SYMPOSIUM – MANAGING FLYING-FOX CAMPS

Prevention is better than cure when managing flying-fox camps

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Background

"Prevention is better than cure" according to flying-fox carers and conservationists in Australasia. Key issues of concern to carers and conservationists were discussed at a plenary session of the Symposium on the *Biology and Conservation of Australasian Bats* in April, 2007. The three main topics addressed related more to megabats than microbats, but many of the concepts have broad application. Overall aims were to share experiences, to share solutions, to avoid re-inventing wheels; to provide strength in numbers and mutual support, collaborating to achieve common goals. Attempts were also made to air and explore some different approaches, since a different angle can sometimes solve a local problem; this also expanded our understanding of the rationale for some of the different decisions taken by other carer groups. Each topic elicited agreement that *every camp is different, and each event is different.* Luckily there is an enormous wealth of experience, goodwill, creativity and perseverance amongst carers and carer organizations.

Heat Events

28 heat events have been recorded between Brisbane and Melbourne since 1999; there may have been others; most have occurred in the temperature range of 40 – 46°C. Unpublished data from Peggy Eby and colleagues has shown that black flying-foxes (BFF) are more sensitive than grey-headed flying-foxes (GHFFs); typically BFF are affected between 39 – 44°C; GHFF seem fairly tolerant in this range, but are seriously affected at 45°C and above. Does this reflect the events occurring where BFF are in a marginal part of their geographic distribution, with lower humidity? Little red flying-foxes (LRFF), present during some of the heat events, were not affected to 43.5°C; no data are available for this species at higher temperatures.

Adults cope better than juveniles. When BFF are affected, about a quarter of the dead are juveniles; when GHFF are affected, temperatures are often higher, and juveniles represent almost half of the deaths, despite only being a third of population in those camps at those times. An extreme example is shown in Figure 1. Juveniles of all ages are affected; there is no sex difference in juveniles affected but there is sex bias amongst adults: females are worse affected than males; and lactating females are more vulnerable than dry females.

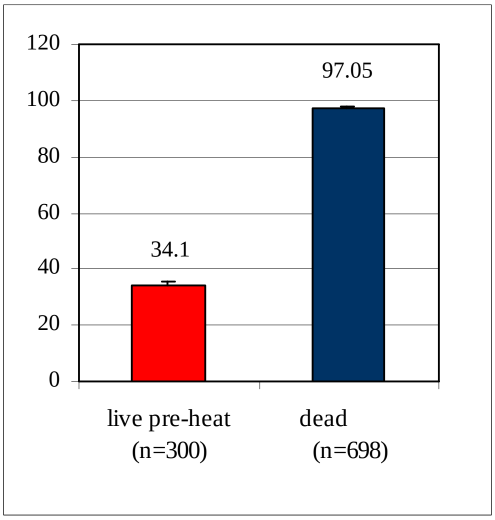

Figure 1. Proportion of juveniles in a camp before the heat event (% young in pre-heat sample) and % young in sample of dead (Eby *et al.* 2004).

Interventions

An example was shared of a camp that experienced similarly high heat with low humidity on separate occasions. Aerial spraying was achieved on one occasion and not the other. Losses were almost completely avoided in the presence of water spray. This camp site also had the problem that animals could not move low down in the trees due to clearing and predation, so falling injuries added to the losses that were due to heat exhaustion.

Non-interventions

Concerns regarding interventions include the disturbance that occurs during spraying, especially when animals are already exhausted. An alternative strategy that may be available in some camps, on some occasions, would be to introduce cooling, humidifying water before the heat event reaches critical level. Compared with aerial spraying, soaker hoses are less expensive, involve fewer logistical challenges, and involve less disturbance. Re-cycled water might be available. It is necessary to obtain approval to alter habitat, so planning needs to be in place before the height of summer. Water quality must also be considered, since damaging the plants will further degrade the campsite.

An example was shared of a camp that is managed in partnership between conservationists, local, and state authorities. The combined management team wishes to avoid disturbance to the animals, but has observed that the creek on which the flying-foxes established their camp is now dry. In part this has resulted from collateral impacts of drought, as domestic use of water is reduced, so there is less run-off for the creek. This group is already working on site, undertaking approved habitat restoration, so they may be able to test the strategy of modifying the local environment to re-create the pre-existing microclimate of the camp, with a view to preventing flying-fox losses during future heat waves.

Cold events

In the Gold Coast hinterland, a sudden drop of 10°C in minimum temperatures one night in November had a serious impact in a camp sited in a cold hollow. The local temperature is thought to have dropped to zero or below. [The author can corroborate the weather event in November, as snow fell at Armidale, northern NSW.] Approximately 200 dead infants and juveniles were collected (from the periphery of the camp, under appropriate permit; disturbance was minimised, and this may have led to data collection being incomplete). Ages of the young were estimated at between three weeks and three months. Two-thirds of the affected animals were BFF.

Multi-factorial events

A report was shared of flying-foxes seen to be deteriorating over a week in a camp in NSW. A sudden cold snap led to deaths of young that apparently ranged from premature infants to about three weeks of age. In this range thermoregulation of young would normally be provided by mums. It appears that the combination of temporary starvation plus cold caused the loss of a cohort that may have survived either of the insults in isolation, but succumbed to the combination.

Prevention

Extreme weather events cannot be prevented. Can flying-fox distress and losses be prevented during such events? Discussants acknowledged that every camp is different and every heat event is different (see Background, above). Bat conservation in this context can be undertaken in three categories (a) long-term management of campsites; (b) plan for welfare work during emergencies; (c) initiate welfare actions early, by predicting heat events.

(a) Long-term management of camp sites

Heat events seem to involve high temperatures with low humidity, often due to hot winds. Management of campsites in affected areas should include attention to the microclimate by:

- improving/protecting undergrowth;
- retaining windbreak trees on boundaries facing the source of hot winds; and
- where appropriate, adding ground water to raise humidity.

These are actions that can be undertaken as part of conservation attempts, with appropriate approvals. Habitat loss is a major threat, and roosting sites are an important part of habitat for survival.

(b) Plan for welfare work during emergencies

- Planning can include organising approval in advance, to enter a camp and attempt to save animals by altering the immediate microclimate (spraying etc) under agreed conditions.
- Organise support networks of rescuers, carers, support for the rescuers, housing and husbandry of a sudden influx of short-term rehab animals.

Several groups have prepared action plans, including provision for being the communications and backup team when sister groups are busy during an emergency. The Department of Sustainability and Environment (Vic) has written a planning manual for use in such instances (*Protocols of management of grey-headed flying-foxes at Yarra Bend Park during severe adverse weather events.* DSE, April 2006). A mobile high-pressure spray, the "heat-stress relief shower", has been funded by AUSTROP, constructed by Bat Rescue Gold Coast, and is available to groups in need.

(c) Initiate welfare actions early, by predicting heat events
Responses during emergencies might include intervention in a camp, such as aerial spraying, or misting close to the ground, and rescue and treatment of affected flying-foxes. If the short-term interventions are initiated early, it should be possible to prevent flying-fox losses (in those campsites amenable to intervention).

It has been a common experience that there *is about two days' warning* of a heat event – unusually high temperatures with unusually low humidity. Carers near an at-risk colony check regularly, and begin preparations for dealing with heat-stressed animals. On the morning of the third day, if conditions have not improved, *bat behaviour clearly indicates the onset of problems*: bats move low in roost trees, and endeavour to keep out of the sun (Figure 2a). These behaviours indicate the need for short-term interventions to avoid disaster (see Figure 2b), and show that long-term action has not yet succeeded at the particular campsite.

Figure 2b. If help does not arrive, large numbers of flying-foxes die, and fall to the ground (Photo P. Eby).

← Figure 2a. On the morning of a heat event, grey-headed flying-foxes can be seen clustering low in branches, and on the shaded side of tree trunks. (Photo P. Eby).

Spraying water onto animals will help with cooling, but may cause panic and unnecessary losses. Spraying water onto foliage near animals has been reported to be well tolerated, and animals help themselves to drinks. Getting water through a canopy or above animals has logistical and economic difficulties, as well as concern for disturbance of the bats. Difficulties include sourcing of water during level 5 water restrictions; bush-fire fighting is often occurring at the same time; storing water on site has infrastructure needs and maintenance; and staffing is needed. But this is an activity that can involve unvaccinated helpers.

Managing Conflicts with Neighbours

Currently, in NSW alone, there are known to be three camps that are under formal applications for intervention; a further seven camps have continuing or repetitive problems with neighbouring communities, and some of these are, or have been, the subject of applications for "disturbance". Equivalent problems in Queensland, Victoria and, at times, the Northern Territory, are well-known. In an atmosphere of sharing solutions and exploring some different approaches (see Background, above) the discussion focussed on managing camps *in situ*, and addressing potential irritants before they emerge as sources of conflict.

How early can we spot problems? New problems will arise, but some are predictable:

- Cyclone Larry has brought spectacled flying-foxes into conflict with some orchardists who had not previously experienced problems with flying-foxes.
- Camps are initiated (or reinhabited) in areas already occupied by human communities.

<u>Prevention</u>

The main strategy to prevent conflicts with neighbours is to avoid disturbance to existing camps. If attempts are made to move a camp, flying-foxes will often move to less desirable locations, where the potential for conflict is greater than at the original site (Hall 2002; Roberts *et al.* 2007). Approaches that were agreed may reduce problems included:

- Manipulate the way flying-foxes utilise a given camp site. Camp modifications to draw animals away from neighbours are being tested (a) by planting fast-growing roost trees in preferred parts of the available camp; (b) by removing undergrowth where roosting needs to be discouraged, and enhancing undergrowth in the preferred parts of the camp; and (c) by investigating the possibility of spraying chemical deterrents in buffer zones, to retain satisfactory distance between roosting flying-foxes and neighbours. [Note that any intervention at a camp requires the usual state government approval, even if its aim is habitat restoration.]
- "Buffer zones of tolerance" can be achieved around existing camps, if potential property buyers are alerted automatically through local government title searches if there is a camp nearby.
- Groups of conservationists who develop custodial intentions toward particular camps need to develop strong partnerships with their local governments, as well as state and federal authorities who have jurisdictions over the animals or the site. Some inspiring examples of this were shared, and the gains accruing to the flying-foxes can be great.
- Be prepared: prepare maps of each known campsite; establish the tenure of the land; network with local communities.
- Positive media – everyone send out one positive story this week – many local news media appreciate help to fill their pages; clear pictures will assist acceptance of a story.
- Be entrepreneurial – promote ecotourism opportunities associated with the presence of flying-foxes and their roost sites.

Wing Injuries

<u>Fencing</u>

Tolga Bat Hospital has a welfare and conservation project to promote wildlife-friendly fencing. Monitoring wildlife injuries on barbed wire fences has shown that the main group affected is flying-foxes, followed by gliders and raptors. Removing barbed wire from fences where possible, and modifying the remainder to give animals a chance, will assist large quantities of fauna in addition to flying-foxes (Maclean 2006). Wildlife-friendly fencing material has been mounted on the web, so that we can all make use of the it in any education or lobbying we undertake in our own areas, thus having a multiplied effect (see Background, above).

See stark illustrations of injured animals, including flying-foxes on barbed wire fences at:

www.wildlifefriendlyfencing.com

Netting

Figure 3. A flying-fox trapped in netting. Note the tight wrapping around the left wrist; the multiple twisted, tightly-tied entanglements on the right wing and fingers, often at awkward angles; the animal is completely restrained and entrapped. Much of the damage results from disruption of blood circulation to the entangled body parts. (Photo Michael Jupp)

Ku-ring-gai Bat Conservation Society has been leading the lobbying to remove the risks to flying-foxes that result from incorrect netting of backyard fruit trees: the problems arise from use of inappropriate material (monofilament netting) or incorrect installation (slack rather than taut, and draped on rather than spaced off the fruit). Progress appears to have been made, with monofilament netting taken off shelves, but staffing changes led to its return. Signage placed on netting at point of sale was achieved for a time, then was lost. Retailers now want the signage and lobbying to be done at wholesale level, not retail. Despite the gruesome injuries, no-one has yet been prosecuted for harming protected fauna.

Nothing can be achieved without numbers.

Evidence must be accumulated, if anything is going to be achieved. There is strength in numbers, and showing that the problem is repeated around the country adds weight to our calls for change. Initially photos, stories and numbers of injuries and rescues can be uploaded onto the Flying-Fox Information and Conservation Network (FFICN) website. Later it might be appropriate to arrange for ABS to host this web-based resource. Again, as with the 'fencing' material, everything that a group or individual carer contributes to the central pool of information remains available to that carer group, as well as the information that has been shared by others via the website. How do you join or access FFICN? See Klose and Pinson (2006).

Information about FFICN and how to join, can also be found at:

http://au.groups.yahoo.com/group/FFICN/

Description of correct installation of netting is at:

http://www.sydneybats.org.au/cms/index.php?id=17,22,0,0,1,0

http://www.batrescue.org.au/documents/Guidelines%20for%20fruit%20netting.pdf

Healing

Attempts to repair the wings of injured flying-foxes have progressed significantly in recent years. Damage to open membrane areas are usually arrested rapidly by application of macadamia oil (Hopper-Hallinan and O'Brien 2005). Preventing desiccation of the membrane allows normal rapid healing to occur. This has greatly reduced the number of long-term problems, such as loss of large areas of wing membrane needed for flight and lift, growth of thick scar tissue which restricts wing extension, and die-back of finger bones, further reducing flight membrane area.

Figure 4. Constriction of wings causes bruising, which is often not visible at the time of rescue. Subsequent death of the tissue can leave bats with insufficient wing membrane to fly. This bat has large holes between digits 2 and 3; 4 and 5; and 5 and forearm. A flightless bat will starve to death quickly if not taken by a predator.
(Photo J. Hopper-Hallinan)

The most challenging problems have been wounds over bones and joints. Judith Hopper-Hallinan demonstrated a number of treatments being used. These included the use of dressings and wound coverings; physiotherapy and scar management during healing; and infection control. Treatments under development aim to be economical, and available over-the-counter, to ensure their availability to all carers. Several participants shared advice on ways to ensure that animals are 'flight-ready' before they are released.

Prevention

- Lobby to remove barbed wire from fences where its use is not critical to a farming enterprise.
- Lobby to have microfilament netting removed from sale.
- Teach all backyard fruit growers in your area the correct way to mount netting over their trees, in ways that will prevent injury to flying-foxes, birds, and other wildlife.
- Apply macadamia oil to wing injuries, and begin other treatments as early as possible, to ensure animals are truly rehabilitated to the wild.
- Contribute numbers, experiences etc to central databases, to assist national conservation efforts.

Consensus

- Prevention is better than cure.
- We need numbers for lobbying; use FFICN for now, maybe ABS later.
- Act *before* heat waves, and at the *start* of heat waves.
- Act *before* camp nuisance becomes camp conflict.
- Act to *remove causes* of wing injuries; when they do occur, treat injuries immediately.

Acknowledgments

Co-presenters included Peggy Eby, Lynda Stevenson, Nancy Pallin, Trish Paterson-Wimberly, Viv Jones, Billie Roberts, Gwen Parry-Jones, Les Hall, Jenny McLean, Marjorie Beck, Judith Hopper-Hallinan and the many attendees, discussants, and sharers who participated.

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Young grey-headed flying-foxes feasting on watermelon during a crèche event in the Northern Rivers area in 2006. Photo Stefan Klose

– Research Notes –

A new southern record for the east-coast free-tailed bat *Mormopterus norfolkensis*

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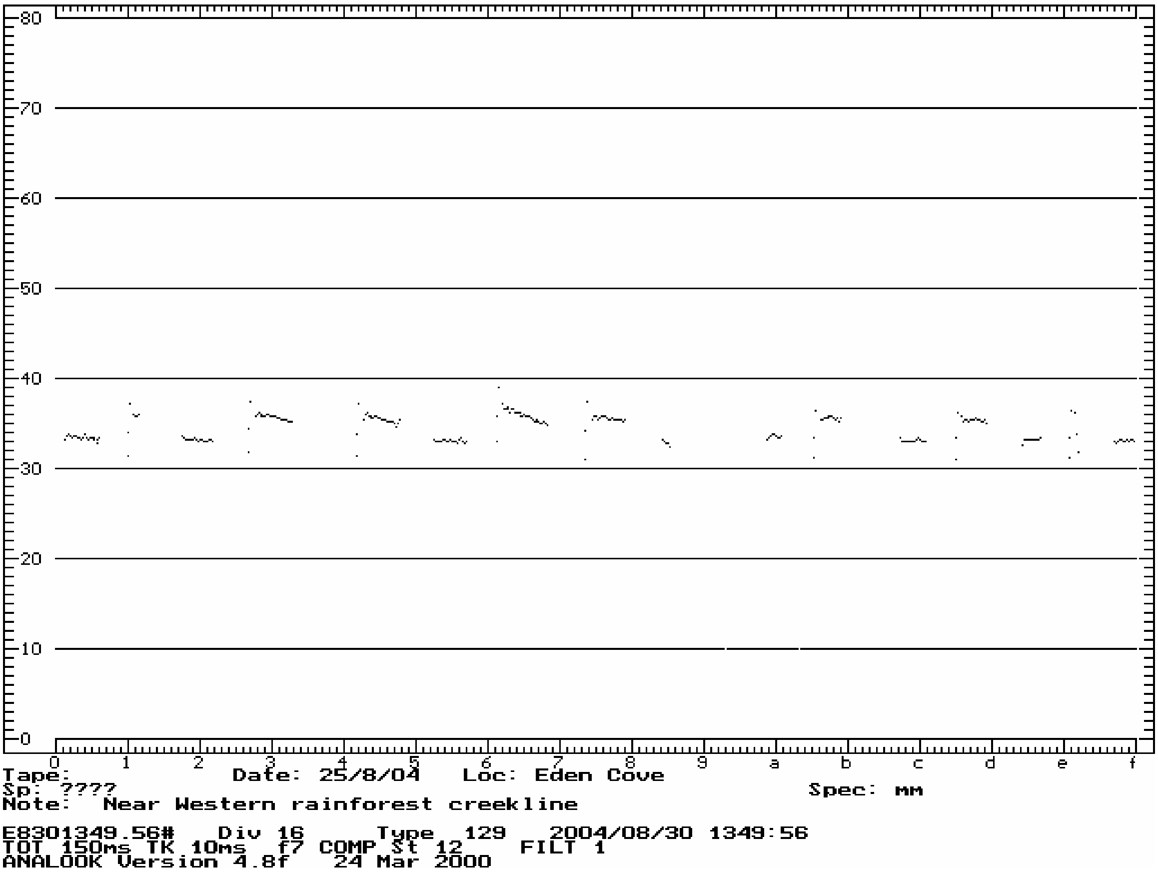
The east-coast free-tailed bat, *Mormopterus norfolkensis* is known to occur along the east coast of Australia, from southern New South Wales (NSW) to Brisbane in southern Queensland. However, its southern limit is poorly defined. Strahan's (2002) distribution map shows the southern limit near the Batemans Bay area, while Churchill (1998) puts the southern limit near Sydney. The NSW Wildlife Atlas (www.wildlifeatlas.nationalparks.nsw.gov.au) shows the southern-most record just inland of the coastal town of Narooma (accessed on 21/6/2006). The majority of records are from dry eucalypt forest and woodlands (Strahan 2002).

During an ecological assessment in August 2004, we detected the east-coast free-tailed bat through Anabat recordings at Eden on the far south coast of NSW. The species was detected foraging between an ecotone of open blackbutt forest and cleared land less than 1 km north of Aslings Beach (37°02´45″S, 149°55´00″E). Anabat detectors were set on the ground at nine stations over two nights, and recordings were made by a hand-held cassette recorder. A total of 27 Anabat hours was recorded.

We identified the east-coast free-tailed bat from the distinctive flat call that alternated between minimum frequencies within the range 30 – 35 kHz (Reinhold *et al.* 2001; Figure 1). The most likely alternative identification is the eastern free-tailed bat *Mormopterus* species 2, which calls in the range 29 – 36 kHz, (Reinhold *et al.* 2001). However, *Mormopterus* species 2 does not produce alternating frequencies and their calls lack the typically short initial and down-sweeping tail of the east-coast free-tailed bat (Reinhold *et al.* 2001). Less than five sequences were recorded during the surveys at two of the nine Anabat stations. Calls were recorded on two separate nights, with the records c. 1 km apart. The records are c. 105 km south of the southern most record in the NSW Wildlife Atlas and 370 km south of Sydney. They are also 40 km north of the Victorian border. Interestingly, the species was not recorded in another recent survey for bats undertaken just to the south of Eden, but about 20 km inland from the coast (Law and Chidel 2001).

There are several possible reasons why low activity levels were recorded during the surveys. The population of east-coast free-tailed bats within the area could be small, or the bats may not have been actively foraging within the range of the Anabat detectors. Alternatively, since microchiropteran bat species are sensitive to ambient temperature, the cool, late winter weather at the time of the surveys may have limited their activity.

The identification of the east-coast free-tailed bat south of its known distribution in cooler climates poses several questions. Has the east-coast free-tailed bat always been in the local area of Eden and survived until now undetected? Does Eden mark its southern limits or does it occur south of the Victorian / NSW border? Has the population extended south in recent years (which have been relatively warm), and will its range expand further with global warming? Further ultrasonic surveys are recommended in southern NSW and Victoria, targeting remnant vegetation and paddock trees on more productive land (e.g. Law *et al.* 2000) to more precisely define the distribution of this poorly known species.



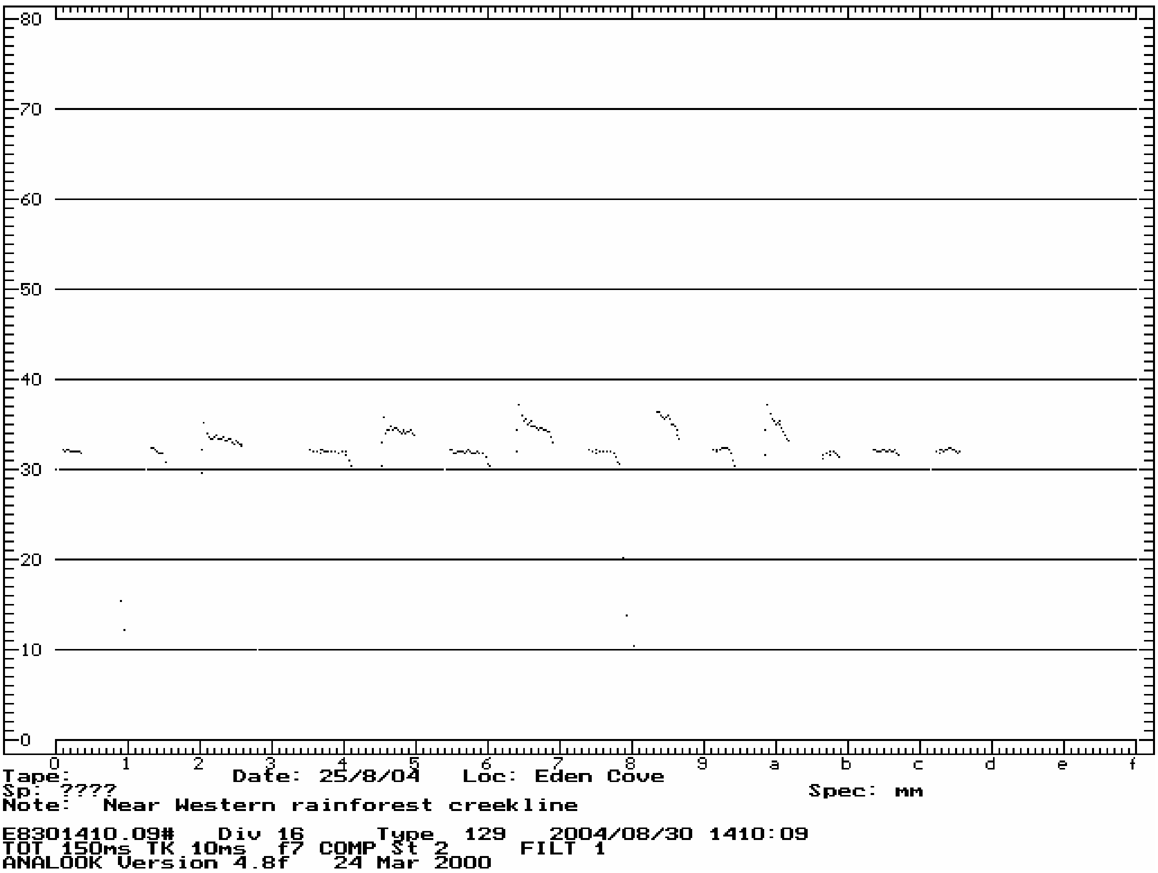


Figure 1. Two Anabat sequences of an unknown bat recorded near Eden, identified as the east-coast free-tailed bat *Mormopterus norfolkensis*.

Acknowledgements

Thanks to Brad Law for a second opinion on the identification of the unknown calls and for comments on a draft of this note.

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Wing healing ability. Terry Reardon took this photograph of a captive eastern free-tailed bat *Mormopterus* species 2, after taking a small amount of wing tissue using a biopsy punch, for a genetic study. Three weeks later Jenny Maclean reported that the hole had healed completely, leaving no sign of where it had been.

– Gadgets and Techniques –

Recharging devices with 5 Volt batteries via USB in remote areas

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An increasing number of small electronic devices are appearing with an internal 5 Volt battery. These are charged through the USB port of a computer, or via a USB cable connected to a small transformer that you plug into the mains. Examples include some mobile phones, iPods, and a digital recorder that I purchased recently. On occasions, I use a Microtrack 24/96 Professional 2-channel digital recorder (M-Audio, USA) connected to a Pettersson D240x detector for night traverses. Generally, I can recharge the Microtrack battery because I will stay where I can access mains power. However, I recently went on a trip where I was away from a power supply for a week or so. Charging via a 4WD socket might be an option for some devices if you have the correct adapter (e.g. satphones, even laptops can be charged through inverter devices) when you are in remote areas, but what if there is no 4WD available?

I found the answer to my problem on the internet. I have shamelessly stolen bits of an article posted to: http://www.hackaday.com/2005/01/28/how-to-usb-battery-v2/ (posted 28/1/05 by Jason Striegel). His idea was to charge the 5 Volt internal battery in the device by connecting it to a square 9 Volt battery. This needs a small 5 Volt regulator LM7805, a 9 Volt battery connector and a female USB connector. Hold the regulator with text facing you (pins from left to right are: input, ground, output), and the USB connector end on with the small plastic *doodad* oriented upwards. Put it together like this (Figure 1):

- terminal 1 of the USB connector → regulator output
- terminal 4 of the USB connector → regulator ground (middle pin)
- battery positive wire → regulator input
- battery negative wire → regulator ground

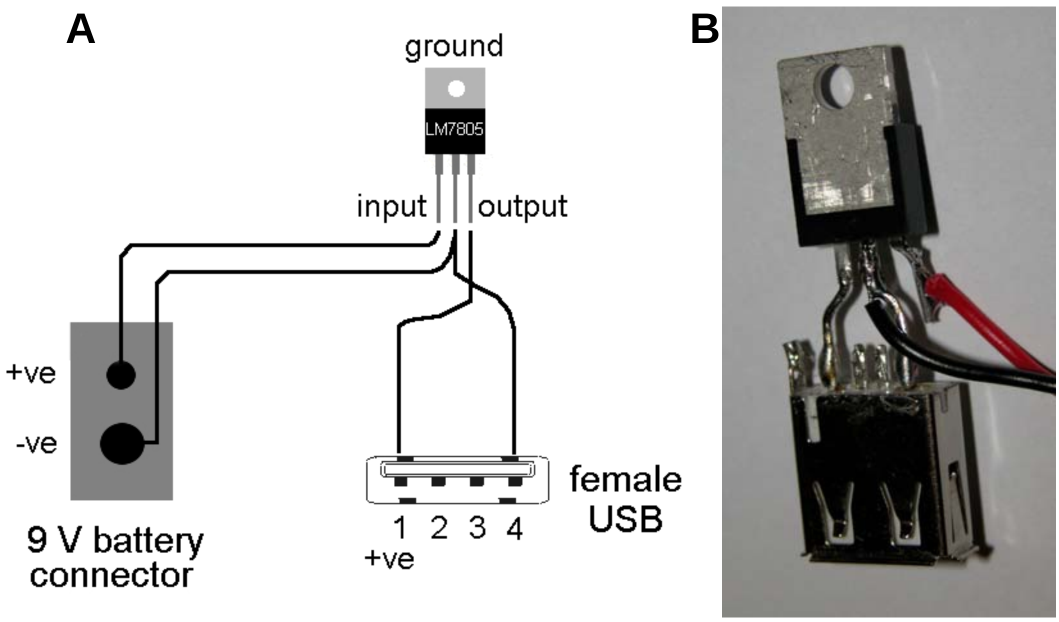

Figure 1. A. Wire it up like this. B. It should end up like this (note regulator is back-to-front compared with previous diagram). Not the neatest job, but it works.

Female USB connectors are hard to find. I cut one off a spare USB extension cable I had. The 5 Volt regulator and 9 Volt connector were bought at Dick Smith Electronics. Everything cost me less than $5.

If you are worried about whether this will damage your device, you can do a small test. Plug a male USB end into the female connector, and put in a battery. Connect the positive and negative ends of a multi-meter to the red and black wires of the male USB part respectively. If it reads close to 5 Volts, then it is wired correctly.

I connected mine to the Microtrack and it began charging immediately (Figure 2). I haven't tested how long it takes to give a full charge, but I imagine you could wander around the bush using it while it is charging if you really needed to. I quite like the Microtrack because it saves time-expanded sound in WAV format onto a CF card, avoids tape hiss at all frequencies below 40 kHz, and separates the left and right stereo channels (heterodyne from time expanded signals). I have some problems with aliasing, so the system is not perfect, and a little cumbersome (wishing I could afford the latest Pettersson D1000x), but it works and now I can charge it in remote areas.

Figure 2. The Microtrack takes a mini USB connection, and the remainder connects in the sequence shown.

Miscellany of techno-tips

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Attaching glow sticks to the fur of bats
At the risk of telling you something you may already know or do, herewith I convey a method of attaching glow sticks to bats. I have always used Skin Bond, but somehow every trip the container lid loosens and it runs everywhere. I gave some glow sticks to a colleague for a project but was out of Skin Bond. I just suggested to him that he simply use sticky tape ... i.e. cut a 10 mm length of tape, put the glow stick in the middle on the sticky side, and sandwich a few belly hairs between the ends of the tape. He reported back that the technique worked well. We have since used the method successfully although it is a little more fiddly than glue. I think one advantage of this method is that the bats should be able to groom off the tape/glowstick easily.

Remote monitoring of harp traps
I have been thinking about monitoring harp traps with spy cameras ... e.g. if you have five traps in the bush, it would be nice to have a cheap spy camera on each and send the video signal back to a monitor in camp. The problem is that most AV senders are pretty weak – you are lucky to get 50 m line of sight. It becomes expensive to up the power, and even beyond legal power it only gets a 1 km line of sight, and much less through the bush.

So I connected my Anabat to a hand-held UHF radio that has voice activation and placed it in a harp trap bag. UHF radios can be pretty cheap and send signals a good distance – around 2 km. So you could have a UHF and detector mounted on/in each harp trap set on a different channel at each trap, and monitor the traps from a single radio at camp that scans through the selected channels at each trap. The system worked really well. Each time a bat came into the trap, it was heard readily from the radio back at camp. Instead of an Anabat detector, a cheaper unit such as Tony Messina's simple detector would probably work really well.

Of course acoustic monitoring is not as good as visual, but it might be useful in circumstances where you need to monitor traps remotely. I couldn't help wondering whether sending the signal via CB radio from an Anabat to another radio connected to a ZCAIM / laptop would work. I tried it with a hand held bat. It sent the signals fine, but the calls came out on ANABAT6 at a much lower frequency, although in the right shape. More work on that is needed.

Reflective tape
Self-adhesive reflective tape is really useful for bat work. I put it on my harp traps and mistnet poles and holders – makes them easy to spot in the bush. I also stick small bits on most of my gear so they are spotted easily at night. Reflective tape is expensive here in Australia but cheap on eBay from the US.

Headtorches
There are lots of cheap LED headtorches around now. I tried some cheap ones bought on eBay (19 LEDS and 37 LEDS; Figure 1). The 37 LED failed the first night (the switch failed), but the 19 LED version has been reliable. I think the Energiser headtorch (bottom in Figure 1) available from major hardware stores has been the best and most hardy. It retailed for about $32 but I saw them in a supermarket recently for $16.

Figure 1. Cheap LED headtorches.

Lenses and field microscopes
Examining bat teeth and genital features usually requires some sort of magnification. I have tried a range of lenses etc. An ideal feature is that the magnifier doesn't need to be hand-held, so that you have both hands to hold and manipulate the bat.

Plastic or aluminium jewellers eyepieces (loupes) at 4x or 10x are good (Figure 2). They can be held in the eye or have an elastic band attached to hold them at your eye. Dick Smiths and other places have some jeweller's glasses with variable-sized lenses, which are also useful (Figure 2). The problem with both these systems is that you have to somehow orient a light source (head-torch or other).

I tried using a small spy/web camera attached to a laptop via USB so that the small bits could be easily seen on the laptop screen. Unfortunately this was clumsy and also suffered from having a very small depth of field for very close-up applications. I am now favouring a relatively cheap (~$200) but good quality ISSCO 20x field binocular microscope (Figure 3).

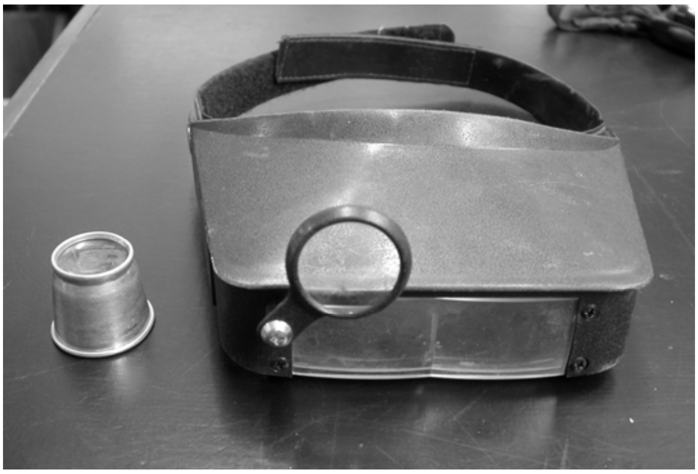

Figure 2. A loupe, and jewellers glasses.

Figure 3. ISSCO 20x field binocular microscope

Mist net pole holders

I used to use guy ropes on poles, but for ages now I have been using pole holders (Figure 4). They are made from steel rod, some flat bar and tubing and simply welded together. I get mine galvanised and they last for ages and don't rust. Good for pivoting nets over dams, tanks etc.

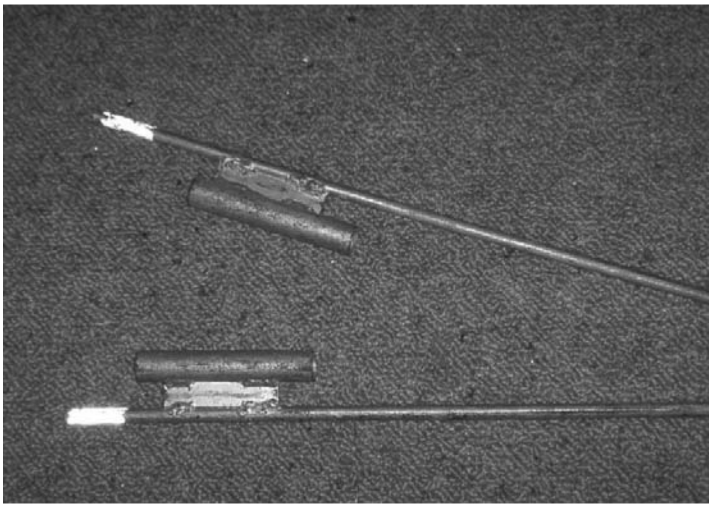

Figure 4. Mist net poles. Note reflective tape on the top.

Bat Chirper as an acoustic lure

A few us have now tried using the Tony Messina Bat Chirp Board (on feeding buzz mode) as an acoustic lure for bats on mist-nets and harp traps. The chirpers are expensive (~$120) so I only own one and haven't done proper statistical tests with replicates, but my observations are based on several nights now and I feel convinced that they do work. The most convincing results are when I have used the chirper at one end of a mist-net on low bat activity nights, and most bats are caught within two metres of the chirper. Stan Flavel suggests that these acoustic lures could be built for ~$25. Perhaps we could then buy/build a bunch of them and do a proper experiment to see if they actually work as I suggest, and for what bat species.

In-flight bat photography set-up

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Kyle asked me to write up how to set up my in-flight photographic system for bats. My system is really cheap, cost about $160 to make (including flashes) and I use a $350 Nikon Coolpix 4500 camera. My aim is not to capture bats in flight in natural circumstances although of course you could adapt the system for that. My aim is simply to get attractive images for books, brochures, and talks to promote bats and their conservation. So the system described below is something that is set up in the field for photographing bats upon release after they have been captured and measured.

The system works as follows: the bat is released through an infra-red beam, which triggers a relay and sets off the flashes. The camera is used in open shutter mode (Bulb or 4 – 8 secs) and is pre-focussed at the plane of the beam.

There is of course an ethical issue to consider when photographing bats. Photographing bats on release is, in my view, mildly stressful to the bats, though probably less stressful than the capture and handling processes. For rarely captured bats, I recapture the bat in a mozzie net set-up over the frame system, and rephotograph the bat. I think each bat is different and I limit the number of times I photograph an individual bat to four or fewer times, depending first on how I feel the bat is coping, and then on the relative need to get a good photograph of that species.

It should be said that the digital medium is ideal for this because you can readily make adjustments to focus and lighting during a photographic session, and experimentation doesn't cost much. But the bats choose their own flight path through the beam, so be prepared to accept that great pictures are still a small percentage of all those you will take.

Complete list of components:

1. Slab of cold Coopers in the esky.
2. A digital camera that can be set to 'bulb' OR has manual time setting to 4 or 8 seconds AND you need to be able to set a manual focus; e.g. digital SLRs and some point-and-shoot type cameras. I use an older model Nikon Coolpix 4500 (4 megapixels) which can still be found on eBay for ~$350. Small point-and-shoot digital cameras have a formidable depth of field and are forgiving with focus.
3. Flashes. Three are preferable, and these need to be set to flash at durations less or equal to 1/10 000th of a second to freeze the bat motion. I use a Sunpak 433D, which has manual settings down to 1/16th power, which equals 1/10 000th sec. I bought my last one on eBay for $20. Dedicated flashes with digital SLRs can also be set to flash at short duration.
4. An infrared beam sensor – the type that uses a reflector. I paid ~$70 for mine but they may cost a little more these days. You could use a ~$30 kit from Dick Smith's. The beam must have an internal relay to trigger the flashes.
5. Three flash synch cords to run from the flash to the beam sensor relay. These can be hard-wired together or you could get a triple plug adapter. You may also need hot-shoes with sync cables. You could use just one direct cable and two flash slave units to fire the flashes. More expensive cameras and flashes have wireless flash triggering.
6. A 12 volt battery (small gel cell) to run the beam sensor.
7. Tripod to hold the camera.
8. A frame (square frame 60 cm x 60 cm) to support the beam and flashes. Mine is made from Brownbuilt angle iron, and some modified filing cabinet support bars, and is just bolted together.
9. A 'G' clamp to hold the frame to a table, several rubber bands, gaffer tape, some ¼" x 50 mm bolts with nuts.

10. A mossie net.
11. A table.
12. Some dark cloth ~20 mm x 20 mm; e.g. a face towel, handkerchief, (or even a bat bag will do in an emergency).

Before going to the field

1. You must make the frame, and flash supports.
2. Set up synch cords – these connect to the NO – Normally Open terminals of the sensor. I put DC plugs on the end of each of the flash cables, and then made a little box with DC plugs (these were wired together and a lead connects to the relay on the beam; Figure 1). You could use the normal flash cable plugs and buy a 3-way flash adapter, though I had trouble with these not working well.

Figure 1. My flash junction box.

3. Make a power cord for the battery to the sensor (Figures 2 and 3).
4. You may have to modify the sensor a little; i.e. remove a capacitor on the output of the relay.

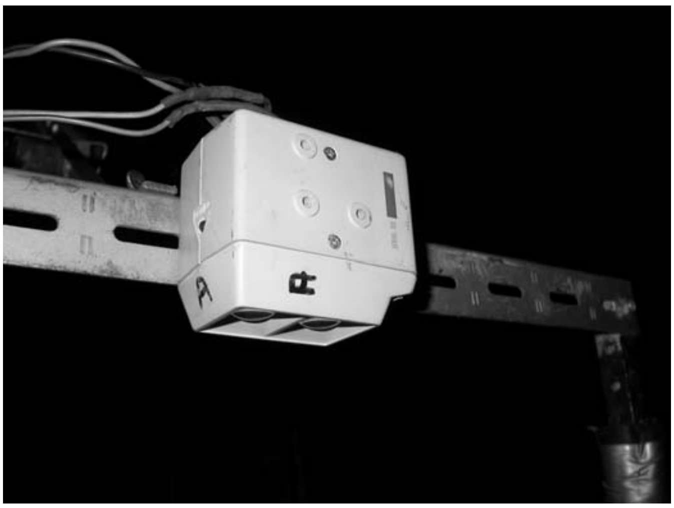


Figure 2. The IR door beam.

Figure 3. The IR door beam (12 V power and relay connectors).

The field set-up

The set-up should look like something in Figure 4.

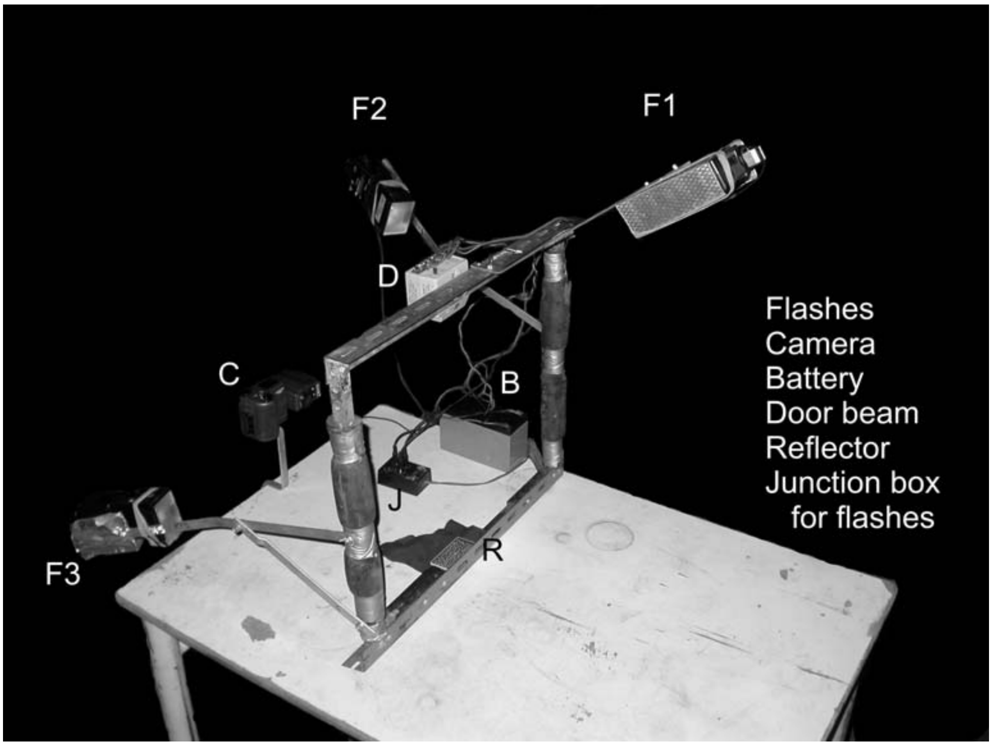


Figure 4. Overall set-up.

1. Set up the table.
2. Attach the frame to the table with the G clamp.
3. Bolt the sensor to middle top of the frame with a bolt.
4. Position the camera and flashes using tripods (flash setup is important but it is a bit of trial-and-error).
5. Connect the sensor to the 12 Volt battery.
6. Place the red reflector on the table below the sensor. You may need to put some non-reflective cloth under the reflector if the table or frame reflects the beam.
7. When the beam is reflected back to the sensor from the reflector, the red LED should light up. Slide the reflector to the side until the LED goes out. Then move it back but stop as soon as the LED lights up. This will mean that the smallest break of the beam will set it off.
8. Test that the beam breaks by quickly passing your hand through the frame; i.e. the LED goes out and you should be able to hear the relay trip (Note: once the relay triggers, it doesn't reset for 3 – 4 seconds).
9. Connect the flashes to the relay, turn them on, and then test the system again using your hand, and make sure all the flashes flash.
10. Turn on the camera and set the time to bulb or 4 or 8 seconds exposure. Set the F stop to maximum (mine only goes to about F7). Then set the manual focus to whatever distance the camera is away from the frame. I usually have the camera about 35 cm from the frame. Small digital cameras (as opposed to the new digital SLRs) have extraordinary focal lengths. I generally set my focal distance to 30 cm for the camera at 35 cm away from the frame plane. Note: turn OFF the camera's own flash (it will be too slow and blur the image). You may need to reset the white balance for flash too.
11. For effect, I usually set up some vegetation around or even behind the frame.
12. I test the system by throwing a glove, hat or some other textured and coloured object through the beam.

13. So get a glove, press the shutter and throw!!!! Hopefully all the flashes go off and you have taken an in-flight pic of a glove!!! This is the time to adjust focus, exposure, etc. Note: the exposure is best adjusted by moving the flashes closer or further away.
14. Setup the mozzie net if you have bats you want to keep or re-photograph (Figure 5).
15. Start taking bat pics. I usually have an assistant operating the camera (Figure 6). I hold the bat by the forearms, and on the count of three, get the assistant to press the shutter and I throw the bat through the frame. It takes some practice to get the bat in a good pose and going through the beam and your hands out of the shot – most of my pics have my hands somewhere there but they are easily photo-shopped out afterwards.

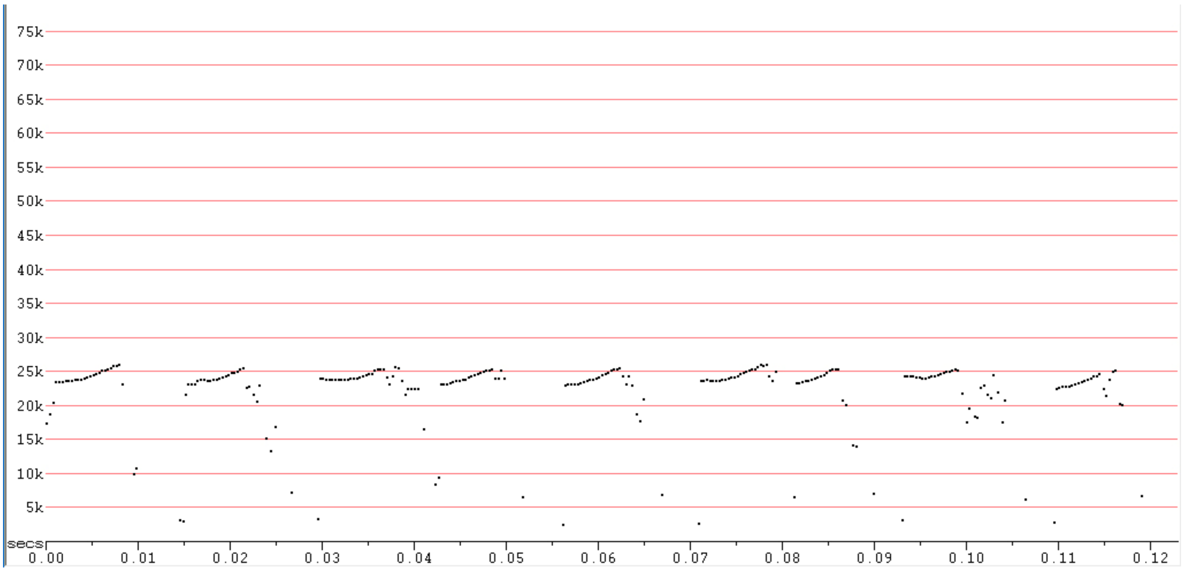
Figure 5. Using a mozzie net for recapture.

Figure 6. The system in action (the first version of the set-up with only two flashes). Note that this system needs to be used in the dark.

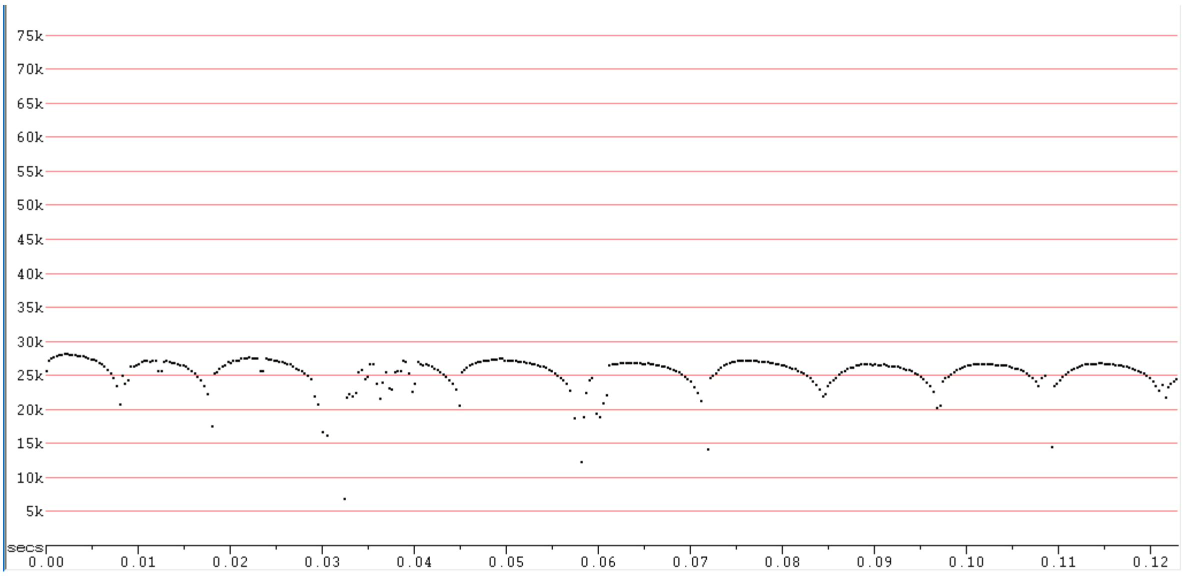
Weird bat call corner

Terry Reardon had another one of his terrific ideas at the Sydney conference – a regular section for presenting echolocation call sequences that leave us deeply troubled. The Newsletter invites people to submit unusual bat calls that need identification, are instructive, show examples of regional variation or are just unexplainable. If you have comments or ideas on any of the calls, please share them with everyone using the ABS listserver: post to abs@listserv.csu.edu.au *If someone has a mysterious call sequence and knows with complete certainty what it is, we might run a little competition. Terry has made the first submission below, followed by our other Ideas-man Rob Gration. – ed.*

Terry Reardon's …

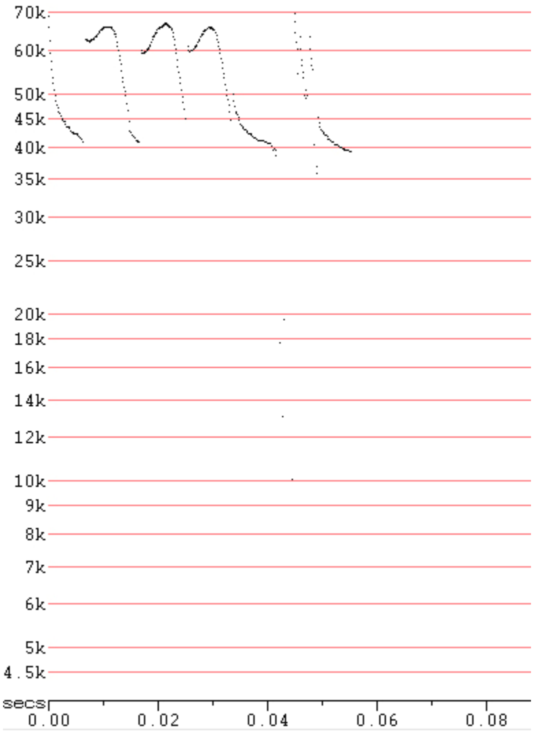


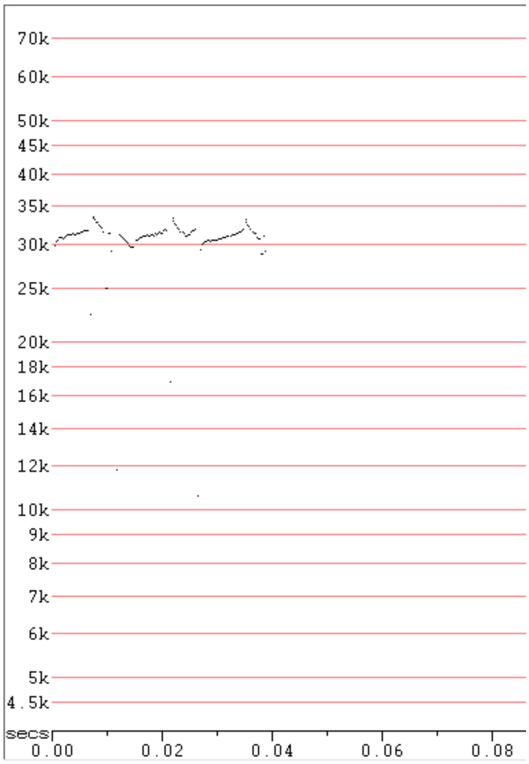
Recorded over small dam in woodland near Kuranda, Far North Queensland by Terry Reardon and Stan Flavel, November 2006. The detector was placed facing a dam where we were mist-netting. Chris Corben suggested that the consistency of the pulses across the entire sequence indicated that it probably came from a stationary bat. The call may be from a bat in the net. I (TR) was excited that it might be from a new *Mormopterus* species.

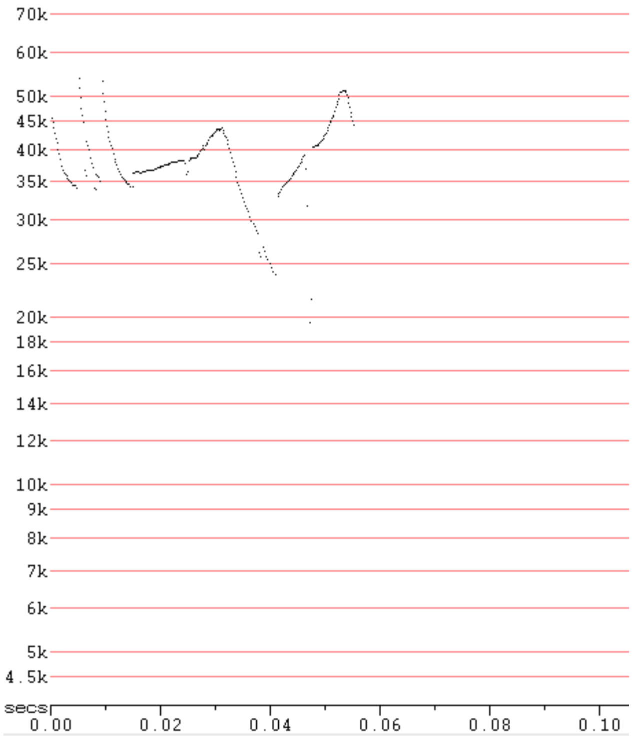


Recorded by Greg Ford on coast near Cairns in mid December 2006. Identification uncertain but Michael Pennay suggests the shape of pulses is similar to *Hipposideros diadema* in PNG … although the frequency very different. Anyone else have an idea of this call?

Rob Gration's …







– Reports and Viewpoints –

Miniopterus schreibersii bassanii and climate change

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The southern bent-winged bat *Miniopterus schreibersii bassanii* occurs on the south coast between Warrnambool (Victoria) and Robe (South Australia). The entire population depends upon only two maternity sites, Starlight Cave near Warrnambool, and Bat Cave in the Naracoorte Caves World Heritage Area, the latter being by far the larger of the two. Bat Cave was the first cave to have a permanent infrared video camera system installed within it, basically to provide for public viewing of the bats during daylight hours. The cameras have also filled a valuable research function by allowing remote observation of lifecycle patterns and behaviour. Visits to the cave are kept to a minimum, especially when pups are present.

The population at Naracoorte has been impacted by a significant change to the usual weather pattern experienced in southern Australia. The cave is in the south-east of South Australia, which has just experienced the driest year on record. Added to this, the number of extremely cold evenings through October to December greatly exceeded the average. These factors in combination have reduced the success of the breeding season and are a valuable example of a species being impacted by climate change.

The total rainfall recorded at Naracoorte airport, approximately 7 km from Bat Cave, was 273 mm. This was the lowest recorded since records began in 1868, and less than half the annual average of 578 mm. A closer analysis reveals rainfall early in the year and then very low winter and spring rainfall, resulting in no surface water in any normally-reliable wetlands in the district. Significant changes in average temperatures were also recorded from October to December.

The minimum temperature for October fell below 5ºC on 18 occasions, and included seven sub-zero recordings. The average daily minima for November and December were 0.6ºC and 2.1ºC below the long term average, but this masks the extremes – November had 9 evenings of 5ºC or less and December evenings fell to 2ºC or below on 5 occasions. Such low December temperatures occur around once every ten years.

The maintenance of the video system revealed the large number of deaths of bat pups in 2006. No pups had been observed by 7 December when a late night visit was made to the cave to clean camera housings to ensure clear images over the summer holiday period.

A nursery had been established in a part of the cave not clearly visible to the cameras, and which had not been used previously as a nursery site. Many dozens of pups were clinging from the ceiling in an emaciated state, and over 300 were counted either dead or dying on the cave floor. A second visit was made one week later and the stench of dead bats was quite strong throughout the maternity chamber. The number of emaciated bats clinging from the ceiling had dramatically reduced, as had the number of freshly dead adult bats. A third and final visit to observe the nursery was made on 20 December. This trip was kept short, as it was obvious human presence was disturbing the pups, now almost fully furred but still well short of their first flight.

The number of pups that died is difficult to determine, but is estimated to be in excess of 500 and represents a significant impact on a population that has already declined from over 100,000 to less than 35,000 since the 1960's. A number of dead pups were collected for further analysis, but in the absence of any quality information from previous pesticide analyses of dead bats, we suggest the reason for the large number of deaths is likely to be related to climate.

The available food for the bats had been reduced severely, firstly by the lack of water and then by the unusually cold evenings. The pups would have been born from late November through to early December when many evenings were cold. It is likely that the lack of food led females to abandon their young, which resulted in the significant number of deaths. The number of dead pups reduced dramatically from mid December, which coincided with a sharp increase in both daily minimum and maximum temperatures – and presumably an increase in available food.

During this period, water availability in Bat Cave also appeared to be an issue. Normally, bats regularly visit drip sites in the cave to drink during the day. Some regular watering points dried and some bats apparently moved to other caves in search of water. These bats were never sexed, but if nursing mothers did not return to Bat Cave it may be presumed that their pups perished. Several dead or dying adults were also found on the floor of a neighbouring cave with torn wing membranes, probably a result of wing membrane desiccation due to the lack of water. Attempts were made to provide water through various means in the cave, but then 100 mm of rain across three days (one third of the previous year's total!) from 19 January negated the need for this.

This species returns to Bat Cave in September, or thereabouts, each year to give birth, raise their young, then increase their body weight and often mate prior to the onset of cold conditions in April and May. Changes in weather patterns such as that observed in 2006 thus pose a significant threat to this species.

A tale of survival

as related by Jenny Clark for *The Belfry*, the magazine of the Sussex Bat Group, England.

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Early in July, Roger Jones, a bat worker in East Sussex, England received a call to rescue some bats in Bexhill. On arrival he was given a cardboard box containing what he thought were three brown long-eared bats (*Plecotus auritus*), a male, a female and baby – all traumatised and severely dehydrated as no water had been put in the box. On closer inspection he realised the female had 'too many legs' and was actually a mother with her baby. He quickly recognised that they were beyond his help and so took them to Jenny Clark's bat hospital at Forest Row.

Jenny examined the bats and confirmed their extreme dehydration and under-nourishment. It was apparent that the bats had been in the box for several days without water or the means to feed. The mother's milk had dried up and so her baby was especially vulnerable. The other baby in the group didn't belong to this female, as Jenny estimated that it was about two weeks older than her baby. Jenny immediately started feeding them a special milk compound which also contains nutrients, to speed up their recovery. Amazingly, all four survived.

As the two adults recovered they started to feed on meal worms. Eventually the mother's milk returned and she was able to feed her baby, leaving Jenny with only the slightly-older baby to feed. One day when Jenny came to feed the youngster she couldn't find it at first. She discovered it eventually tucked under the mother's wing, feeding from her other nipple!

The bats grew stronger day by day as they lived together in Jenny's incubator. She began to place some mini mealworms in with the group and eventually the youngsters weaned themselves and started taking these mini meals. The mother required extra support in the form of supplements and calcium, since feeding two infants was taking it out of her. Jenny had to carefully lift the mother out of the incubator together with both babies under her wings to feed her. The babies were very curious about this and Jenny had to keep them covered with a paper tissue, which had been warmed on her kettle, whilst mum fed.

At this stage, a third juvenile brown long-eared bat was brought to Jenny that had been taken into the vet, again anonymously, so with no address where it could be released. It had weaned and was about the same age as the eldest of the group from Bexhill and so Jenny decided to add this youngster to the group and almost immediately it was integrated into the family unit.

Jenny felt that it was now time the adults started to strengthen their flying muscles and the young bats should start to learn to fly, but to save complications she delayed this for a couple of weeks whilst the youngest bat caught up with it's two adopted siblings. Eventually Jenny and Hugh took the bats into their living room, each having an adult and one or two juveniles. The adults immediately flew and then both of them went back and 'buzzed' the young bats to get them to try to fly. The adult male fully participated in this exercise, encouraging the juveniles and helping them to learn. The babies took off and landed on the curtains where both adults again 'buzzed' them to have another go!

Jenny then put them all in a flight cage and whilst she flew them in her living room every few days, she also watched them flying round their cage on other nights as they continued to strengthen their muscles. After the young bats had become confident flyers, the adults then took them into the corners of Jenny's living room and taught them to hover.

At this point Jenny had to start to think about releasing the bats, but of course no one knew where they were from. She therefore decided to release them close to her home where there is plenty of suitable habitat for brown long-eared bats. She removed all the hangings (tea towels, trouser legs etc.) from the cage and put in three bat boxes, two built of wood and a woodcrete Schwegler box, all with mealworms placed inside. The bats began to use the bat boxes as day roosts, preferring the Schwegler box, possibly because it offered a more stable temperature. Jenny was still flying them in her living room and they were getting stronger and stronger and eventually the only factor hampering their release was the weather, which was quite changeable.

A suitable period of weather arrived finally and Jenny and Hugh took all three bat boxes, with the bats, outside and hung them on the wall. The following morning three of the bats were in the woodcrete box and one in a wooden box. The next day all the bats were gone, but Jenny kept all three boxes supplied with mealworms. After the third night Jenny again checked the boxes, to find all five huddled together in the Schwegler box.

Since then Jenny has filled a china dish with mealworms every day and left it in the Schwegler box, and every day it is emptied. Sometimes there are one, two or three bats in the box when she goes to fill the dish. She thinks that the adults have flown off and that these are the juveniles that are using the bat box as a back up. Also she thinks that have they have actually moved round to the other side of her house, as there are brown long-eared droppings now on her kitchen windowsill.

An incredible success story, especially considering that only two of the bats are known to be related!

Autumn bat observations – South Australia 2007

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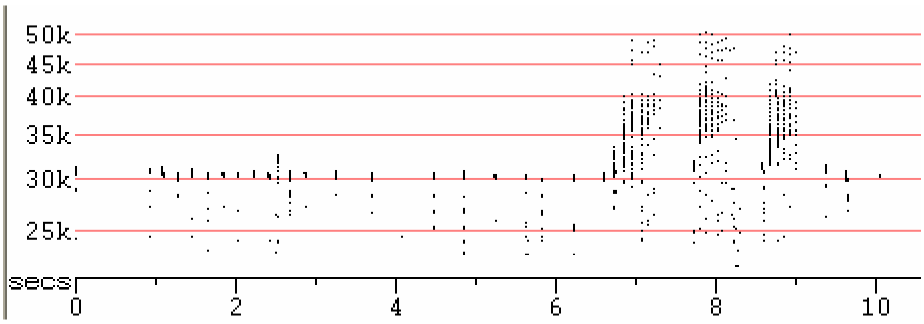
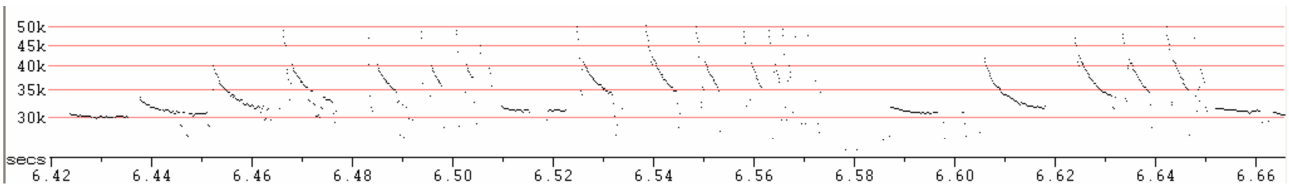
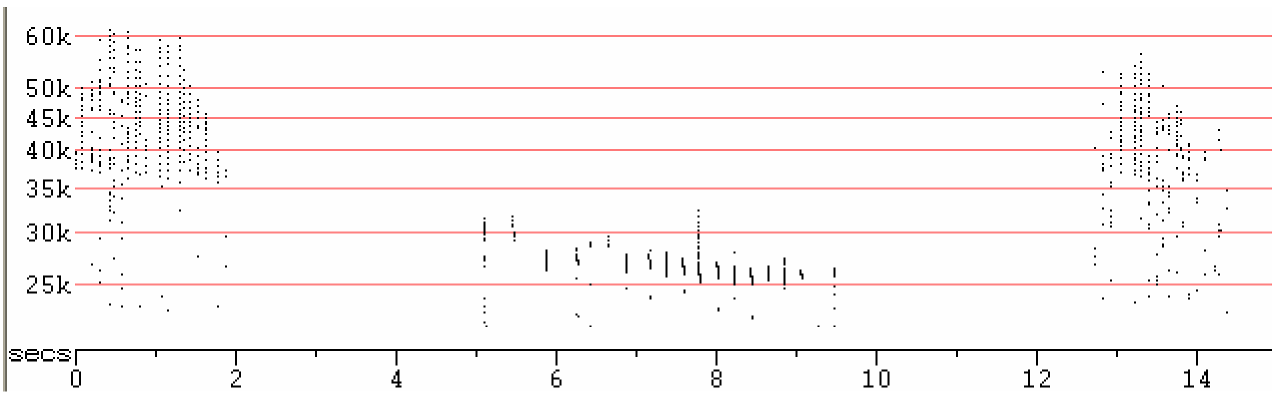
Autumn 2007 has seen a few more bat observations coming from Flinders University students and staff. About two years ago we acquired the new Anabat equipment which collects bat calls directly onto a flash card, and early this year finally learned to use it under instruction from Terry Reardon (and wondered why we hadn't moved over to this technology long ago). Several groups of students have collected a lot of bat call data.

Christer Gunnarsson from Sweden went on Terry Reardon's March long weekend trip to Gluepot in the South Australian Riverland to learn about bats and came back with about 800 bat calls. This was a prelude to doing a bat survey project for our post-grad biodiversity topic *Australian Mammals* at Scott Creek in the Adelaide Hills, where Christer has also collected many bat calls. In mid April, three of our Biodiversity & Conservation students, David Barry, Alena Mogoutonuv and Andrew Murphy, also went to the Riverland, to Calperum, and came back with some nice bat calls recorded along edge areas where woodlands join grasslands. The figure below shows one of their recordings of what appears to be a free-tailed bat, with feeding buzzes (at the F1 and F7 setting in Analook, respectively).





We also have some recordings from around house roosts. Clare and Heiko, whom I've known for some years (as a patron of the Flinders University whole-food shop where Clare worked), have a house in the Bugle Ranges near Mt Barker, which they sometimes share with bats. We have talked about doing some serious recording at their house and finally did it this year, taking advantage of the new Anabat technology, with a few days of recording at both the beginning and end of March. They seem to be sharing their house with free-tailed bats and lesser long-eared bats, as shown in the recording below (F1 setting, Analook).



Some other friends, Kathy and Sean and their two children, live at Bridgewater in the Adelaide Hills, and a mutual friend from our church in the Adelaide Hills told me one day that their home group meeting at Kathy and Sean's place had some excitement one night with a visit from three bats flying around inside the house. The Anabat detector was put to work again in March and suggested that their bats are also lesser long-eared bats. I was treated to the sight of a bat flying around inside and was fortunate enough to get a photo of one outside on another night using our daughter's digital SLR with a flash.

There was also some successful photography of large forest bats in Belair National Park in February and March, again using our daughter's digital SLR. The first series in February were taken without a flash using a 1600 ISO rating film, and as shown below (left), the exposure was still a bit slow and the bat's wings were moving too fast to be captured well. I went back a few days later with a flash and managed to capture a series of bats (and a wattle bird) in the same location. As an aside I was subsequently advised by another friend that it might pay to make sure that the flash and camera electronics are properly compatible, since some old flashes pack too much wallop for the electronics of modern digital cameras and can burn out the flash circuits.

The two pictures above are to be a part of a poster for a conference in Cairns in July. The theme of the conference is Vision. I am presenting a poster on the relation between bat activity and light, having been encouraged by my wife to attend – "Jack and Bogdan who are being honored with Festschrift Dinners are mates of yours, and in any case I want to see Cairns". So we are going to Cairns in July and maybe we'll get to see a few bats.

A review of "Flying foxes cease to function as seed dispersers long before they become rare" and its implications for Australia

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This paper by Kim McConkey and Donald Drake (published in the journal Ecology in 2006: Volume 87(2): 271–276) is, in my opinion, one of the most significant studies on flying-foxes in many a decade, and I have written this article to alert readers to their paper. In essence, their work shows that flying-foxes must be in reasonable numbers for seed dispersal to function effectively and maintain forest ecosystems. A full read would be especially important for people who are concerned about flying-fox conservation, including those who are involved in legal proceedings about these animals.

The following extracts from their study crystallise the major issues:

> "*For most trees in sites below a threshold abundance of flying foxes, flying foxes dispersed less than 1% of the seeds that they handled. Above the threshold, dispersal away from trees increased to 50% as animal abundance approximately doubled*".
>
> "*When flying fox abundance increases, animals in fruiting trees repel newcomers who may snatch a fruit to eat elsewhere, thus dispersing the seeds*".
>
> "*The concept that fruiting trees must be 'saturated' with flying foxes for seed dispersal implies a non-linear relationship, in which flying foxes cease to function as seed dispersers when their abundance falls below a critical threshold*".

Now we have evidence that flying-foxes must be preserved in "ecologically effective" densities, and as the title of their paper states so succinctly, they cease to function as dispersers well before they become rare.

How and why does this happen? In the mid-1980's it was discovered that spectacled flying-foxes (*P. conspicillatus*) dispersed seeds in two ways. Either small (< 4 mm) seeds were moved by ingestion and later defecation, or large fruits were moved by carriage in the mouth (Richards 1990). Importantly, studies in Central America at the same time showed that the further a seed was relocated away from the parent tree, the greater its success in establishment as a seedling (Janzen 1983).

Many people know quite well the sound of flying-foxes squabbling in food trees at night. There is more to this than meets the eye, more than just the defence of food or a feeding territory – it relates to what is known as the "raiders versus residents" seed dispersal model (Richards 1990, Hall and Richards 2000; Figure 1). Raiders often snatch a fruit before they are evicted from a tree by others, flying away to a safer tree nearby, thus dispersing diaspores (fruits with seeds) away from the parent tree. I twigged to this process when I made the mistake of camping in an old shed on Cape York that had mango trees with ripe fruit next to it, and was kept awake all night as flying-foxes attempted to carry fruit that was too heavy away from the site, dropping the odd one on the tin roof! The "raiders versus residents" seed dispersal model has been demonstrated a number of times in overseas studies, and is the basis of the McConkey and Drake paper.

However, the shattering conclusions by McConkey and Drake are that the model will only work if the flying-fox population is above a certain threshold. In other words, if there are ***not*** enough flying-foxes to fill all the territories in food trees in any given area, and then ***not*** enough to come in and squabble and raid and depart, then no seeds will be dispersed. All the seeds from large-fruited trees will be dropped below the parent tree, and no seedlings will be successfully produced.

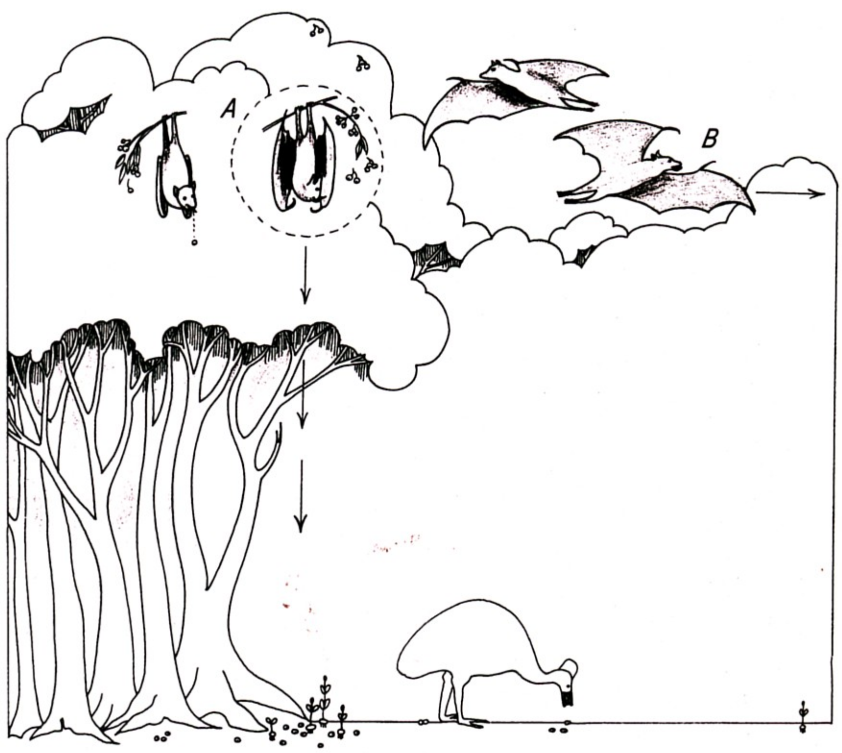

Figure 1. Illustration of the "*raiders versus residents*" model, drawn by Louise Saunders, and scanned from Hall and Richards (2000). Residents are marked as "A" and raiders are marked as "B".

Kim McConkey and Donald Drake conducted their research in Tonga over several years (1999-2001). They used line transects to assess the amount of fruit available during the day, and at night assessed numbers of bats. They developed an index of flying-fox abundance which they explain as follows:

> "*FFI (flying fox abundance index) is based on the number of flying foxes counted per hour (within 600 x 40 m transects) relative to the percentage of trees with flowers or fruit that are consumed by flying foxes (i.e., an estimate of the number of animals per food tree at the time of study: FFI = FF/T, where FF is the number of flying foxes seen foraging per hour within 20 m either side of the transect and T is the percentage of trees with flower or fruit that is consumed by flying foxes*".

The study area in Tonga was a myriad of different islands, and the bats would track the food resources from island to island. They visited eight physically distinct sites with significant rainforest cover, from one to four times, with 5 – 13 months between repeat visits to any one site, and observations were made on three nights for each site visit. They also measured the seed rain from 85 food trees (14 species), all of which had ripe fruit with diaspores (fruits with seeds) that were too big to swallow, and could only be carried by mouth. They categorised the seed rain by whether it had fallen beneath the edge of the tree crown (un-dispersed) or whether it had been taken up to 45 m away. They could identify diaspores that had been dispersed by other animals such as rats by checking the type of teeth marks on the skin.

Their results are very interesting, if not alarming. The flying-foxes were responsible for 91 – 100% of the dispersed diaspores for 13 of the tree species studied. There was a non-linear relationship between flying-foxes and their effectiveness as seed dispersers, and there was a break in the plot of the FFI between 0.77 and 0.81 (Figure 2). For trees at sites with an FFI below the threshold, very few seeds were dispersed along the 45 m diaspore transects, compared with trees where the FFI was above the threshold.

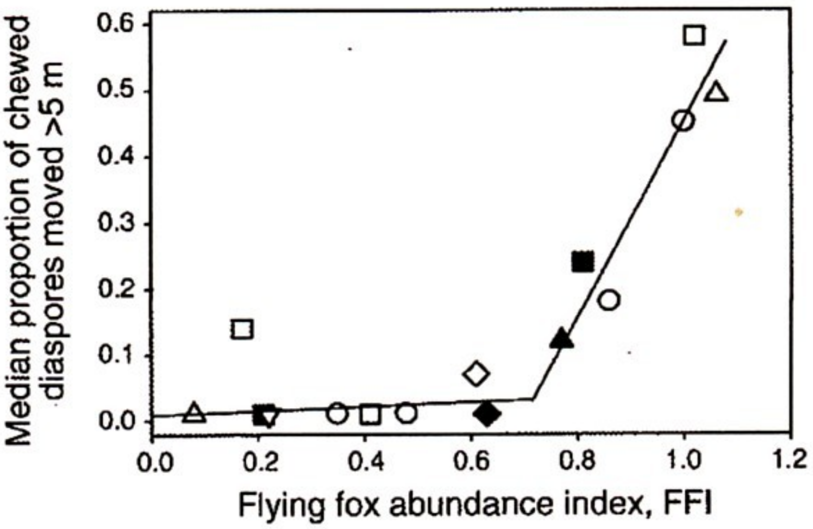

FIG. 1. Relationship between flying fox abundance and median proportion of diaspores dispersed >5 m at each site in Vava'u (Tonga, Polynesia). Lines are fitted separately to the data points above and below the threshold flying fox abundance required for them to function as seed dispersers of large fruit. Points of the same shape and fill represent repeat visits to the same site.

Figure 2. Scanned from McConkey and Drake 2006.

Although it would be good to demonstrate the same scenario in Australian flying-fox seed dispersal, I don't think it is really necessary. The concept is simple enough, and the implications for Australia and other countries that have flying-foxes are quite enormous. For example, in Australia and its territories, four species are now probably below the ecological threshold that is discussed in the McConkey and Drake paper, including:

The spectacled flying-fox *(P. conspicillatus)*

Numbers of this species now appear to be below the "ecologically effective" density in the Wet Tropics World Heritage Area, but this would require further and precise study. Because this species may have a preference to feed upon highly visible light-coloured fruit, which now may not be dispersed, then a long term change in rainforest tree species composition may result.

The Torresian flying-fox *(P. banakrisi)*

Whether you believe that this taxon is a good species or not, the bottom line is that it provides ecosystem services to the unique rainforest that is present on about one-quarter of the isolated Moa Island in Torres Strait. Reduced numbers would equate to reduced seed dispersal services in an ecosystem where there are few other vertebrate dispersers that can handle large fruit, such as pigeons.

The Christmas Island flying-fox *(P. melanotus)*

This species is known only from Christmas Island, an Australian Territory in the Indian Ocean, south of Indonesia. There are a few large frugivorous birds on the island, and the majority of the avian fauna are fish-eating seabirds. One would assume then, that the primary ecosystem server for the unique island rainforest would be this flying-fox species. Its populations were once estimated at around 10,000, a density that would suffice for an isolated area of around 300 km^2.

Unfortunately, it appears that the majority of the population were blown out to sea by a cyclone in 1988, so no longer can one expect the same level of rainforest interaction. The resultant effects upon this rare rainforest type are unknown, and in time dramatic changes may occur. Certainly though, any decline is today several orders of magnitude greater than that a few decades ago, and one may assume that it has declined to the point of McConkey and Drake's "ecologically effective threshold".

The *grey-headed flying-fox* (*P. poliocephalus*)

Who knows what may be happening with ecosystems that are dependent at whatever level upon this animal, probably the most persecuted species in Australia. Its numbers have been reduced to the point where it now features in threatened species legislation in several states, and also at a national level. Assuming that the rigorous study by McConkey and Drake applies to other species, then segments of Australian subtropical ecosystems will be in trouble in the long term.

To finish, I would like to congratulate Kim McConkey and Donald Drake on an excellent piece of research that, in time, will be an alert to all bat conservationists. All courts in the land, all land managers, and all opponents of flying-fox conservation should take note, and I hope this article will be a case in point to act upon. One day down the track and in years to come, when the implications of Kim and Donald's work rings true in currently deaf ears, the "powers that be" will regret not listening to them.

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A grey-headed flying-fox. Photo Lindy Lumsden

Bat surveys in Mozambique: Maputo to Niassa

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Unknown territory is much coveted by biologists. Therefore the paucity of bat data from Mozambique, especially the north, made it the perfect destination for a bat inventory trip. Prof Ara Monadjem from the University of Swaziland, me – his Australian sidekick – (April Reside), new recruit Julien Cornut and for a short time Kim Roques were the bat survey team to cover Mozambique from the Swazi border in the south to *Reserva do Niassa* on the Tanzanian border in the north. The ute was loaded up with 150 L of petrol, 160 L of drinking water, five weeks worth of rice, lentils and tinned food, and most importantly mist nets, poles and two harp traps, and then we set off with a vague route and itinerary.

To maximise our bat catching potential, we sought water holes, forested corridors or streams. The first night we camped just outside the village of Palmeira by a small muddy water hole, got eaten alive by mosquitoes and caught one bat – *Scotoecus albofuscus*. The next day as we approached a bridge across the Limpopo River, the telltale scent of a molossid roost reached Ara and I simultaneously. We jumped out of the car and raced along the bridge to try and access the bats inside the gaps in the bridge. We discovered a colony of *Mops condylurus*. Further along we searched concrete culverts under the road and discovered a *Nycteris macrotis*. We enjoyed a beautiful camp under baobab trees with nesting brown-headed parrots and a barn owl near the Limpopo, and netted around a deceptively benign-looking water hole (but I'm sure it bred schistosomiasis and malaria-carrying mosquitoes) for the second night. We caught *Scotophilus leucogaster* and *Hipposideros caffer* there.

We drove north through Bauhnine National Park, the acacia savanna and mopane woodland reminiscent of Kruger, to Massangena on the southern bank of the Save River. We naïvely expected a bridge (it was shown on a map). Although we had five languages between us, neither Portuguese nor the local language featured. So it was through sign language, and the odd Zulu, English or Portuguese word that a group of locals convinced us that we they would be able to push our car through the 200 m wide Save River. Five hours and two flat batteries later, we reached the northern shore well after dark with all belongings (including books, clothes, bat detector, batteries and laptop computer) drenched. We camped on the flat river sands to dry out, and netted in the *Acacia xanthophloea* gallery forest remnant where we added *Epomophorus wahlbergi*, *Nycticeinops schlieffeni*, *Scotoecus hindei*, *Scotophilus dinganii* and *S. viridis* to our list.

At the Buzi River we were inundated with *Mops condylurus* and caught our first *Triaenops persicus* for the trip, with Ara and Julien recovering from an attack of the fire bean vine. We were quite disappointed to find much of the riparian vegetation in the Chiniziua Forest to be cleared and settled, but found a nice woodland patch where we caught *Rhinolophus landeri*, *R. hilderbrandti*, *Neoromicia zuluensis*, *N. capensis* and the ultra elusive *Myonycteris relicta* (just the second record for southern Africa). Between Chiniziua and Inhaminga we found a large cave complex. We escaped attacking tsetse flies by descending into the cool of the caves, where we could smell and hear the *Rousettus* camp before we reached it. We flushed out some *Rhinolophus hilderbrandti* and caught 11 which was a good opportunity to build up our echolocation-call library. We set the harp traps on the track next to our camp and set the nets down at the entrance to the cave. The harp traps quickly filled up with *Triaenops persicus* with a few *Hipposideros caffer* and *Miniopterus inflatus*, and our nets were being eaten vigorously by *Rousettus aegyptiacus* and *Hipposideros vittatus*.

Triaenops persicus

At the montane tea plantations of Gurué we caught *Lissonycteris goliath*, *Myotis tricolor*, *Rhinolophus clivosus*, *R. blasii*, *Miniopterus fraterculus*, *Hipposideros ruber* and a frightened local on a bicycle. The surprised man was on his way home from work on his bike when he hit the net, and came to the likely conclusion that we were witch doctors after his liver. He hurled rocks and abuse before running as fast as he could back up the hill. Needless to say, there wasn't much left of our net!

Lissonycteris

Tadarida fulminans

On the outskirts of the rural village Ribáuè, we waited for the men to finish bathing in a muddy stream before stringing our nets across it. The unassuming stream produced eight species, including *Scotoecus hindei*, *Tadarida aegyptiaca*, *Chaerephon ansorgei*, *Epomophorus crypturus* and *Tadarida fulminans*.

After two weeks on the road we reached the 'civilisation' of Pemba to enjoy ocean swims and seafood. Despite having some 'time off' we managed to find *Nycteris grandis* in a baobab tree at a tourist camp and *Chaerephon pumilus* in someone's roof. Heading west we finally reached the Greater Niassa area. We didn't add any new bat species to our list, but we did catch a barn owl, and found our first sign of big game: elephant spoor over our tyre tracks from the previous day. Continuing towards Marrupa we encountered extremely bad roads with precarious logs masquerading as bridges, all of which was taking its toll on our long-suffering vehicle. We were stalled in Marrupa for 2 days with the car in the tender care of enthusiastic but ill-equipped bush mechanics.

Despite their best efforts we had to postpone our venture into *Reserva do Niassa* and detour to Lichinga for some serious vehicle repair. The generous bush mechanic accompanied us to Lichinga to help us get the barely-operational car going every time it broke down en route! ("Car*o* problem*o* GRANDE!")

At Lake Niassa we caught *Rhinolophus fumigatus*, *Nycteris hispida* and *Myotis bocagei* among lakeside banana plantations. We'd caught some small, golden-yellow juvenile *Epomophorus minor*, and got taken on a wild goose (bat) chase through the hills looking for caves. We found rock dassies (small terrestrial mammals that are most closely related to whales), but no bats.

Back to the Greater Niassa area, another modest muddy puddle outside a village produced plenty of bats including *Sauromys petrophilus*, and to my excitement, a bat hawk, which subsequently regurgitated a slimy *Triaenops persicus* for our inspection. We crossed the Lugenda River and finally entered *Reserva do Niassa*, our northernmost destination. The beautiful reserve added the excitement of elephants, leopards and crocodiles lurking in the background and a wood owl in our nets.

Altogether we traversed from 26^{o}S to 12^{o}S in a month, with 41 species caught from 14 different locations, 6 of which were new species for Mozambique and more than half were range extensions. Despite destroying electronic equipment and books in a river crossing and nearly killing the car, we considered it a successful trip. Can't wait for the next one.

← Bat hawk

THESIS ABSTRACT

The ecology and conservation of the white-striped free-tailed bat (*Tadarida australis*) in urban environments

Monika Rhodes (July 2006)

Australian Digital Theses Programme – Griffith University: http://www.griffith.edu.au/ins/collections/adt/

Of all anthropogenic pressures, urbanisation is one of the most damaging, and is expanding in its influence throughout the world. In Australia, 90% of the human population live in urban centres along the eastern seaboard. Before European settlement in the early 1800s, much of the Australia's East coast was dominated by forests. Many of the forest dependent fauna have had to adapt to forest fragmentation and habitat loss resulting from clearing for urbanisation. However, relatively few studies have investigated the impact of urbanisation on biodiversity. This is especially true for the remaining fauna in large metropolitan areas, such as Melbourne, Sydney and Brisbane.

The physical and conceptual context of this thesis is the increasing impact of urbanisation and the potentially threatening factors to forest dependent fauna. Bats were selected because they comprise a third of Australia's mammal species, and therefore form a major component of Australia's biodiversity. Very little is known about the ecology and conservation biology of hollow-dependent bats in general, but particularly in urban environments. The study was conducted in Brisbane, south-east Queensland, one of Australia's most biodiverse regions. More than a third of Australia's bat species occur in this region. A large insectivorous bat, the white-striped free-tailed bat (*Tadarida australis*), was selected to study two key resources in this urban area – hollow availability and foraging habitat. This thesis also examined if artificial roost habitat could provide temporary roosts for white-striped free-tailed bats and other insectivorous bats and assessed whether these bat boxes can be used as a conservation tool in urban environments where natural hollow-availability is limited.

The white-striped free-tailed bat is an obligate hollow-dweller and roosted largely in hollows of old or dead eucalypts throughout Brisbane's urban matrix. These roost trees harboured significantly more additional hollow-dependent species compared to control trees of similar age, height, and tree diameter. Roost cavities inside trees often exceeded 30 cm in diameter. Furthermore, maternity colonies used cavities of hollow trunks, which often extended into major branches, to roost in big numbers. Therefore artificial alternatives, such as small bat boxes, may provide temporary shelter for small roosting groups, but are unlikely to be suitable substitutes for habitat loss. Although five bat species used bat boxes during this study, the white-striped free-tailed bat was not attracted into bat boxes.

Roost-switching behaviour was then used to quantify associations between individual white-striped free-tailed bats of a roosting group. Despite differences in gender and reproductive seasons, the bats exhibited the same behaviour throughout three radio-telemetry periods and over 500 bat-days of radio-tracking: each roosted in separate roosts, switched roosts very infrequently, and associated with other tagged bats only at a communal roost. Furthermore, the communal roost exhibited a hub of socialising between members of the roosting group especially at night, with vocalisation and swarming behaviour not found at any of the other roosts.

Despite being spread over a large geographic area (> 200 km^2), each roost was connected to others by less than three links. One roost (the communal roost) defined the architecture of the network because it had the most links. That the network showed scale-free properties has profound implications for the management of the habitat trees of this roosting group. Scale-free networks provide high tolerance against stochastic events such as random roost removals, but are susceptible to the selective removal of hub nodes, such as the communal roost.

The white-striped free-tailed bat flew at high speed and covered large distances in search for food. It foraged over all land-cover types found in Brisbane. However, its observed foraging behaviour was non-random with respect to both spatial location and the nature of the ground-level habitat. The main feeding areas were within three kilometers of the communal roost, predominantly over the Brisbane River flood plains.

As the only mammal capable of flight, bats can forage above fragmented habitats. However, as this study showed, hollow-dependent insectivorous bats, including free-tailed bats, are specialised in their roosting requirements. The ongoing protection of hollow-bearing trees, and the ongoing recruitment of future hollow-bearing trees, is essential for the long-term conservation of these animals in highly fragmented landscapes. Furthermore, loss of foraging habitat is still poorly understood, and should be considered in the ongoing conservation of bats in urban environments.

THESIS ABSTRACT

Morphological variation of the Australian ghost bat, *Macroderma gigas* (Microchiroptera: Megadermatidae) from late Pleistocene to present at Mount Etna, Queensland

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New late Pleistocene faunal assemblages located at Mount Etna, central eastern Queensland, and spanning from 500 000 years old to the present, have allowed the study of morphological variation through time of the Australian ghost bat, *Macroderma gigas*. Analyses revealed that the late Pleistocene *Macroderma gigas* from Mount Etna were significantly different than the modern species from the same locality in having smaller cranial and dental characters, such as the zygomatic region, anterior nose-shield width, palatal length, tooth-row, and M^1, thereby giving the bat a more robust and stockier appearance of the face. While some dental characters varied notably through time (i.e. P^4 first decreased then increased in size), others remained fairly constant (i.e. M^1 and M_3). Finally, late Pleistocene populations were found to share more morphological resemblance with modern populations from the Kimberley region, north-western Western Australia, than they did with populations from elsewhere in Australia (data of Hand and York 1990), especially including modern population at Mount Etna. Whether the modern colony at Mt Etna is part of a continuous lineage since the late Pleistocene or an offshoot of northern populations remains unclear. It is suggested, however, that the morphological changes are likely to be an adaptive response to changes in prey availability as a result of increased aridity.

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– News and Announcements –

Submissions for *Mammal Review*

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As the Associate Editor of Mammal Review, I have been tasked with increasing the submissions to the Mammal Review from Australia. If anyone has any reviews they would like to submit (e.g. literature reviews from PhD theses) could they send me a title and an abstract and I will assess their suitability for submission. Please send them to Iain Gordon <iain.gordon@csiro.au>.

Victorian Advocates for Animals website

Lawrence Pope
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The VAFA website is finally off the ground, if not quite in orbit yet. It can be found at:

http://www.victorianadvocatesforanimals.org.au

On the website you can find information on steel-jawed traps, issues facing our flying-foxes, Melbourne bat information, killer netting and ideas for safer protection of backyard fruit trees. The site will improve as time goes on, but as a first canvas I hope you approve.

More links for African bats

In the previous issue, I drew attention to the 'African Bat Conservation Newsletter' (ABCN), edited by Ernest Seamark under auspices of the Transvaal Museum, and with PDFs available for download from their website at:

http://www.Africanbats.org

There are two other bat groups in Africa with websites that you might like to visit. Peter John Taylor, the curator of mammals at the Natural Science Museum in Durban (and author of 'Bats of Southern Africa') founded the 'Bat Interest Group of KwaZulu-Natal'. You can download some issues of the 'Bat Mag' from:

http://www.durban.gov.za/durban/Tourism_and_Leisure/museums/nsm/pubs/the_bat_mag

There is also the 'Gauteng and Northern Bat Interest Group' (GNORBIG) in South Africa which has its own newsletter. Its chairman is Nigel Fernsby and the website address is:

http://www.batsgauteng.org.za/index.html

– Recent Literature –

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